

October 24, 1960

# Aviation Week

*and Space Technology*

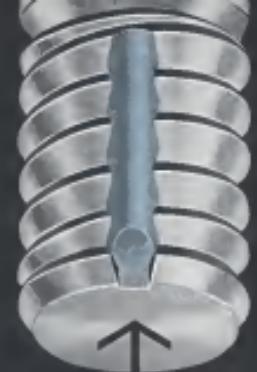
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Grumman A2F-1 Intruder



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Vol-Shan's Long-Lok is a proven self-locking device designed to resist vibration. This insert can be incorporated into any machine-threaded part for use in any medium of temperature ranges from -370°F to +1200°F. Qualified to performance requirements of aerospace/military specifications, Long-Lok is economical—eliminates the need for lock-washers, safety wires and adhesive locking compounds. It is another example of Vol-Shan's relative engineering skills. A letter or your company letterhead brings Vol-Shan's technical brochure without charge. Include your application requirements for a specific reply.



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GOODYEAR PRESENTS CREDENTIAL FOR ANOTHER EXCELLENCE



now the fastest jetliner  
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That's why we're proud to report that Goodyear's wheels and brakes are used by Conquest Division of General Dynamics Corporation on 880's in service and going into service on Delta Air Lines. They're built to stand up under the most punishing loads. For instance, at take-off an 880 may tip the scales at almost ninety tons!

Lots of good things come from

Putting this Goodyear team in virtually a tradition in the aircraft industry. For the past 30 years more commercial airliners have been equipped with Goodyear wheels and brakes than with all other airlines combined. Here's here's sampling of new aircraft relying on their high reliability and low operating cost:

Commanche—Conquest 408    Fairchild 720T  
Boeing—A370    Lockheed L-1011    WP early  
warning plane    DC-10    Lockheed  
Air Force—B-10    Supersonic bomber  
F-100    Lighter-bomber    T-38 trainer  
Army—Grumman G-1    West T-38C-18  
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Executive—Grumman Gulfstream    Lockheed Queen Air  
Light—Aero Commander Model 440P  
Cessna Model 440

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**a message to men who are pioneering the future...** Ponder for a moment the imagination behind Gayley's VERTOL craft of 1942, then marvel at where the industry might be had this pioneer had today's production resources! ■ Because Ex-Cell-O is in business to help relieve you of many development and manufacturing details that can hamper your creativity, in this condensed list of capabilities you may find a means of getting your project off the ground sooner than scheduled! ■ Fuel controls and injection systems, linear and rotary actuators for GSE and airborne applications, air bearing devices, inertial guidance systems, servomechanisms, data processing memory drums, nuclear power plant components, hardened and ground precision production parts. ■ Our Representative nearest you will gladly elaborate on Ex-Cell-O's products and services.



This is the **SWAMI MOTION DETECTOR**, a compact precision detection device for Penetration Protection, Flood and Area Security.

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**Flexibility:** It can function as an omnidirectional or directional system, and can determine relative or absolute speeds of moving targets.

**Durability:** The major unit of the **SWAMI MOTION DETECTOR** is shock-resistant, and its service life compares favorably with that of conventional vacuum-tube detection devices.

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Circle 2

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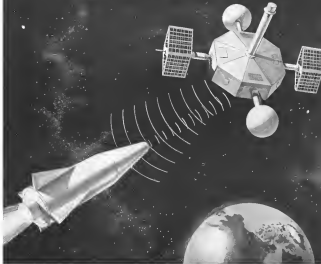


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## AVIATION CALENDAR

(Continued from page 5)

- photo Systems Laboratory Conference (continued), Hilton Hotel, San Antonio, Tex.
- Nov. 24-25—Annual Meeting, Executive Board of the Flight Engineers International Assn. (NTE-CED), Statton Hotel, New York, N. Y.
- Dec. 24—19th Annual Meeting and Audio-visual Exposition, American Rocket Society, Statton Hotel, Washington, D. C.
- Dec. 24—Annual Meeting, National Aeronautics Traffic Assn., Oklahoma City, Okla.
- Dec. 25-26—Aircraft Industry Exposition, California Marine Memorial Temple, San Francisco, Calif. (concurrent with the Atomic Industrial Forum's Annual Conference (Statton Hotel) and the American Nuclear Society's Winter Meeting (Statton Hotel, Washington, D. C.).
- Dec. 27-28—Trade Annual Eastern Air Transport Conference, Hotel New Yorker and Manhattan Center, New York, N. Y.
- Dec. 27-28—Sponsored by Radio Engineers American Institute of Electrical Engineers Assn. for Computing Machinery.
- Dec. 27-28th Wright Brothers Lecture, National Aeronautics Assn., Statton Hotel, Washington, D. C.
- Dec. 28-29-30th Meeting, American Association for the Advancement of Science, New York, N. Y.
- Dec. 28-29-30th Key, George Washington Hotel, New York, N. Y.
- Jan. 9-12—Special National Symposium on Suburban and Durable Growth, Bellevue Sheraton Hotel, Philadelphia, Pa.
- Jan. 9-12—International Congress and Exposition Society of Automotive Engineers, Cobo Hall, Detroit, Mich.
- Jan. 10-12—Special National Meeting, American Astronomical Society, Doherty, Tex.
- Jan. 10-12-19th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. (Theme: Night Drones, Jan. 10).
- Feb. 1-3—Special Winter Military Electronics Conference, Institute of Radio Engineers, Statton Hotel, Philadelphia.
- Mar. 4-5—Radio Engineers Conference, American Rocket Society, Statton Hotel, Washington, D. C.
- Mar. 5-6—Special Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Pa.
- Mar. 10-11—Test, Operations and Support Conference, American Rocket Society, Statton Hotel, New York, N. Y.
- Mar. 16-17—National Conference on Systems Education, Statton Hotel, Washington, D. C.
- Mar. 19-21—International Conference, Institute of Radio Engineers, Statton Hotel, New York, N. Y.



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Before you should unwittingly decide to fly second class in your own corporate airplane, we urge you to check into the AirResearch Aviation Service Company reputation and facility to see for yourself how the finest interiors in the world are made.

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## Another hot job for Janitrol valves



In the Mach 2 all-weather Republic F-105D Thunderchief—an aircraft of striking capabilities—performance depends on a lot of little things. Janitrol pneumatic valves, for instance, belong to the second generation of Janitrol products for the jet and missile age, including high performance heat exchangers, regulators, and couplings—components of the well known Janitrol heaters. In these special fields you'll find Janitrol offers a unique combination of experienced designers, hard-headed production people, and superb plant facilities. Write for "Janitrol Resources," a recent brochure loaded with meaningful photos and selectively low-pressure sales talk. Janitrol Aircraft, 4200 Surface Rd., Columbus 4, Ohio.



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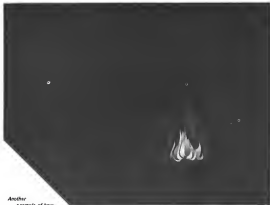
## New Ways To See Fire...

Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to visually monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to see the hidden area. Or, FIDO can be used by landing crews to check out blind areas in missiles and rockets. Image resolution is as fine as one demands!

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These advanced Fenwal safety devices are the end products of long and continuing research. They complement Fenwal's established capabilities in unit and component detectors, and explosion suppression. A Fenwal engineer will gladly supply details. Fenwal Incorporated, 1200 Pleasant Street, Andover, Massachusetts.



Another  
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# FANSTEEL 77 METAL



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When you need to pack a lot of weight in a small space to link any problem—for radiation shielding, vibration dampers, counterbalancing, etc.—design around Fansteel 77 Metal. Your part will take up as little space as possible while providing the service required.

Whether you need extra density for shielding purposes... or just extra weight, Fansteel 77 Metal will do the job... and do it in less space because it's twice as heavy as steel, 50% heavier than lead, much stronger than cast iron.

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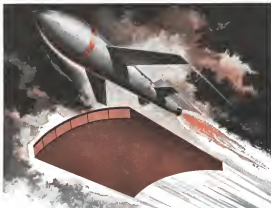
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HIGH TEMPERATURE  
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Johns-Manville Announces... **MIN-KLAD INTERLOK**

... a new structural system interlocking Min-K insulation and high-temperature reinforced plastic

Min-K insulation shows that in certain heat control situations no one material will perform as well as two (or even)—an insulation with protective high-temperature facing.

Protection is how to effectively combine these materials into a structurally strong unit? The answer is Min-Klad Interlok.

... plus the outstanding advantages of Min-K insulation—an insulating unit that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transient. Min-K's thermal conductivity is actually lower than the molecular conductivity of air or—



4) Inner facing



All three above components combine to provide a durable, insulating, shielding, reflecting system.

—a new structural system that interlocks Min-K insulation and reinforced plastic, metal or other high-temperature facing.

The result: one product that gives the inside designer every advantage of high-temperature plastic or metal: full-strength, toughness, rigidity, fire-resistance, high heat capacity?

... plus the outstanding advantages of Min-K insulation—an insulating unit that has the lowest thermal conductivity available for service temperatures up to 2000°F steady-state, and higher for transient. Min-K's thermal conductivity is actually lower than the molecular conductivity of air or—

Wide range of facings  
For the hot face, the inside designer can

specify Min-Klad Interlok in a wide variety of heat-resistant and/or ablating materials—acrylics-phenolics (ARF-40), and similar reinforced plastics, as well as stainless steel and other heat-resistant metal face and metals. For some requirements, the cost here can be made of a different material—for example, one that offers characteristics superior for bonding or fastening to other surfaces and joints.

Like all J.M. American innovations, Min-Klad Interlok is factory-fabricated to your specifications into structural plate panels, heat shields, cylindrical liners or component housings of any shape or size. Write today for technical specifications. Address: Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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# HOW HIGH HOW FAST HOW FAR

AIRCRAFT PERFORMANCE

IS ONLY AS GOOD AS THE  
ENVIRONMENTAL PROTECTION OF THE AIR CREW

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Environmental protection of the air crew is the important link between theoretical aircraft performance and actual flight results. For more than ten years, Scott has designed and produced more possible oxygen equipment than any other manufacturer in the world. Now, Scott also leads in the design and production of high-altitude oxygen breathing equipment for protection during flight or ejection.

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In Flight or Ejected  
His Life is **Scott**  
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The Scott Building Block Design Concept recognizes components block to block, to produce a completely interchangeable, modular system, removable and quickly replaced, without disturbing any other portion of the aircraft.

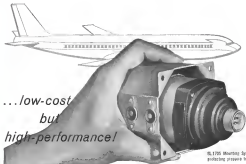
Qualified, experienced Engineers can find full information for their company in Scott's *Survival Study*. Write to: *Survival Study*, c/o William H. Wilson, Personnel Director.



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...low-cost  
but  
high-performance!

SL 1705 Mounting System — shown  
protecting pressure transducer

## vibration control for aircraft instruments

There's a new Lord mounting system for small equipment or instruments on jet aircraft that offers big advantages!

**It's versatile.** Basic design is adaptable to a variety of sizes: transducers, indicators, electronic tubes, gauges, warning and timing devices, accessories. Mounting arrangements permit use on instrument panel, nacelle or other airborne locations.

**It's high-performance.** Lightweight system provides sustained all-altitude control of high-frequency vibrations plus attenuation of shock and structure-borne noise. RTCA's Electromagnetic Mountings possess extreme environmental resistance, excellent damping, superior endurance, consistent performance over -65° to +340° F. range.

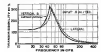
**It's economical.** Simplified design gives you Lord quality at a lower price than competitive basins. Long service life means your maintenance costs will be lower, too.

**It's proved.** The advanced design and performance of this Lord system have been thoroughly proved in actual service on today's jet airliners.

This mounting system is an example of Lord ingenuity. It indicates why you can continue to expect Lord to produce the best in vibration/shock/acceleration control for the aerospace environment. To get this ingenuity to work on your project, or to get further data on the SL-1705 basic, contact the nearest Field Engineering Office or the Home Office, Erie, Pa.

### typical specifications

Application: pressure transducer. Weight: approx. 1.2 lbs. base — 21 lb. shock/vibration protection: 100 g's static; 1000 g's 100 Hz. Mounting: System natural frequency: 45 cps. Operating temperature range: -65° to +340° F. Shock: model resistance: unaffected by temp, dust and salt atmosphere; no corrosion. Damping: control of greatly superior. Inside: Mounting arrangement: designed to allow unit to be bolted to structure without modification.



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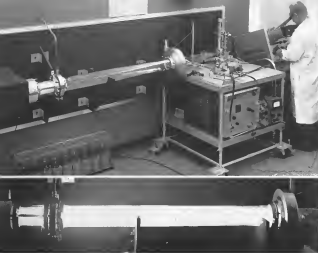
See Lord's "Vibration & Shock Handbook" for more information.

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**BENDIX SYSTEMS DIVISION**

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## NASA Budget Review

## Washington Roundup

Space officials met in Williamsburg, Va., last week to discuss problems and take a look at some new budget needs. Top staff officials from National Aeronautics and Space Administration headquarters and the agency's centers attended the meeting.

Supplemental budget request to launch new communications satellite development programs at one-fifth cost of the Williamsburg session. NASA Administrator Keith Closser has announced that his agency is preparing plans for a lightweight active repeater satellite to orbit at 3,000-5,000 mi.

NASA also wants to move ahead with the passive reflector satellite program it launched with the highly successful Echo sphere. The agency wants to try a more rigid inflatable sphere on its next test, using one of a number of possible techniques to give the satellite greater structural strength in orbit. The approach is considered cheaper in the long run, since Echo set off the objectives for a new rigid sphere and another test would produce little new data.

There is no money available in the current budget for either of these communications satellite programs. NASA will have to get some extra money early in the next congressional session, which starts in January. If it is going to launch an active repeater next year is planned. More money will also be required to produce a rigid sphere for the next Echo shot.

These new programs will raise questions of conflict with military communications satellite programs. Arms in developing active repeaters in the Center and Advent projects. South American and Space Services Comandante is concerned over possible duplication and will warn against its dangers in a report on space priorities.

## Philippine Bid Delayed

Civil Aeronautics Board has delayed action for two weeks on the Philippine bid for a Manila-San Francisco route via Tokyo. The Board postponed hearings on the controversial request from Oct. 25 to Nov. 9 at the request of Northwest Airlines. The center said its workload on other CAB cases would keep it from devoting full attention to the case, which could have an important competitive effect on Northwest.

Philippine government is asking for the transpacific route for Philippine Air Lines despite its denunciation of the U. S.-Philippine bilateral. It is standing firm on its contention that flight frequencies of U. S. carriers to Manila should be restricted and duration of their operating rights should be limited. CAB is expected to grant the route to Philippine Air Lines, but with the proviso that it will be exercised if U. S. services are reduced.

U. S. is against capacity restrictions in this flight, which differs from the recent dispute with the Scandinavian. U. S. Philippine agreement is over traffic being primarily between the two countries. Scandinavian dispute is over U. S. attempts to restrict traffic traveling beyond the countries involved.

Dr. George Kuznetsov, the President's scientific adviser, will stay on the job until a new Administration takes over in January. These have been reports that he would return to Harvard University before President Eisenhower left the White House.

## Management Dispute

Question of who should manage the electronic ground support system for Minuteman (WS-117L) is producing some friction. The choice lies between Air Force Defense Missile Division and USAF's Command and Control Development Division. Management responsibility for the WS-117L data processing center is under development in Thompson Radio Workshops, recently was transferred from BMD to CCDD. But BMD retains management of the WS-117L ground tracking-computer equipment. Philips is developing.

Commerce Department hopes to report to industry within a month on government efforts to facilitate and remove commercial exports. Industry made a number of recommendations at a recent government industry conference, including plans for simplified procedures and more liberal licensing for various types of U. S. commercial products. Commerce now is studying the proposals to see what changes can be made.

Air Transport Union is continuing its fight against Civil Aeronautics Board attempts to remove disputed airlines from its investigation. ATA. The Board asked the U. S. District Court for help in forcing ATA to produce the documents, and the association has told the court the only papers it withheld are those it maintains are "legally privileged."

ATA blamed the Board for delays in the investigation, maintaining that the only obstruction has been CAB's suspension of the investigation July 17 despite the association's request that it be continued.

—Washington Staff

# USAF Accelerates Bioastronautics Effort

Research command seeks to help nation regain lead from Russia by better coordination, streamlining.

By Evert Clark

Washington—An Research and Development Command has begun streamlining and accelerating its bioastronautics research to help regain a leadership that it believes the nation has lost to the Soviet Union in this field.

The new effort will reinforce existent increases in funds for certain critical areas. Revision of this work will affect all Air Force medical research units on active projects, including those outside the command. It has two major goals:

- To effect more thoroughly the level of technology and depth of biomedical knowledge that ARDC must have to meet the strenuous requirements of military space flight programs such as the DynaSoar boost glider.
- To put ARDC in a better position to segment quickly any national civilian space flight program. Having this capability is viewed as important to a requirement for ARDC in supporting military weapon systems since the services—and primarily the Air Force—use providing much of the biomedical support for National Aeronautics and Space Administration's Mercury and Apollo space-flight projects.

If Gen Bernard A. Schriever, ARDC commander, has what he wants, Reg. Gen. Don Puckinger staff support for the command's three major programs. Gen. Puckinger already was Gen. Schriever's assistant for bioastronautics.

## New Clearing Halls

The new assignment establishes Gen. Puckinger's office as a central point of information on applied bioastronautics matters within the Air Force as well as a central point of coordination and approval for most of this work done within the command.

He is given a close line of communication directly to his medical mission commander in three ARDC laboratories—the Aerospace Medical Division at Wright Air Development Division, the Aerospace Flight Laboratory at Air Force Medical Development and the Human Factors Laboratory at Lockheed AFB. Sources oriented biomedical and human factors work at other centers will not come under Gen. Puckinger's direct supervision.

When action requires, Gen. Puckinger's command, who would require a system of staff checks and balances in order to understand and supervise biomedical work, from the coordination of research and development. Although this might appear to be a centralizing step in opposition to ARDC's recent attempts to decentralize authority from headquarters to the

Among the reasons underlying the latest action are:

- Gen. Schriever's conviction that manned missions, both for atmospheric flight and space flight, will be required well into the future.
- An analysis of all Air Force bioastronautics work has indicated that the service's long experience and appreciable resources could be put to better use under the new system.
- Need to meet immediate biomedical requirements, such as those for DynaSoar more quickly.
- Recognition that lead time in the biomedical field is perhaps more critical than it is in other branches of space technology.
- Need for greater emphasis of and support with NASA programs.

ARDC frankly believes that it does not have the knowledge or ability to answer either the variety of or performance questions ascribed in manned space systems.

NASA is being forced in the Mercury project to go from the high government standard of eight months' lead time to a less part of the system had been passed into the unknown of the Mach 15-20 speed transporter and from multiple, separate and widely separated biomedical research projects to a single system requiring much of its more determinations to the biomedical work than single involving less as an experiment or a subproject in a project such as Mercury.

## Orderly Progression

ARDC does not feel it can safely undertake the biomedical requirements of a Mach 15-20 in the military situation represented by atmospheric and orbital flight in a vehicle such as DynaSoar without making the progression that Mercury is being forced to do.

To work with aerospace on the biomedical aspects of a vehicle system is to do it in. For example, there runs from one biomedical laboratory to another to have their biomedical knowledge applied, extended from one area to another, the flight time. Seven years is considered a good comfortable lead time for this kind of capability.

ARDC feels that the U.S. pioneering space medical research beyond earth-orbit and manned flights in America needs around 1969, and hold a clear world leadership until budget and policy decisions cannot meet at this week, to be discontinued in 1972.

Russia, on the other hand, increased steadily and heavily from the U.S. efforts, and in 1973 began what ARDC

research describe as an expensive and healthy program of space biomedical work that has continued through Sputnik, V-2 and has clearly taken the lead away from the U.S.

At Force again last time in its biomedical space work during the long post Sputnik debate about who should do what in the field of manned space programs. Its man-in-space program was shifted first to Advanced Research Projects Agency's responsibility and later to NASA.

When USAF left the man-in-space program around August of 1958, ARDC's biomedical research activities met and prepared their own version of a comprehensive national program of space medical research, including work that should be done to support both civilian and military programs.

The new given to NASA, Defense Department, and the Armed Forces Research and Development Council: Command on Bioastronautics. The plan included advanced facilities and would have been expensive to implement. It did not specify who should do what work. Much of it still has not been implemented.

NASA did not establish its Office of Life Science Programs until March, 1968. A year and a half later, and now to a less part of the system had been passed into the unknown of the Mach 15-20 speed transporter and from multiple, separate and widely separated biomedical research projects to a single system requiring much of its more determinations to the biomedical work than single involving less as an experiment or a subproject in a project such as Mercury.

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# Mercury-Redstone Shots Delayed; Manned Orbit Still Due Next Year

Washington—Some of component malfunctions and delays for delayed launch of the first Mercury-Redstone capsule will now occur, complicating the highly compressed Mercury flight schedule and forcing postponement of the first manned Redstone ballistic flight until next year.

Despite schedule pressure, National Aeronautics and Space Administration still holds its Mercury approach in 1968. The agency officials in March launched delays in the engineering policy means of Mercury managers as contractors, attributing the situation instead to a top-astronautics timetable for personnel systems.

Check-out schedule did not allow for certain failures and subsequent repair. The schedule has proved unrealistic, and the lack of provisions for check-out delays has been a major link in meeting tight flight dates.

First Redstone boosted capsule, designated MR-1, left here in Cape Canaveral on March 31, 1968. A year and a half later, and now to a less part of the system had been passed into the unknown of the Mach 15-20 speed transporter and from multiple, separate and widely separated biomedical research projects to a single system requiring much of its more determinations to the biomedical work than single involving less as an experiment or a subproject in a project such as Mercury.

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## Quality Control Shered

Quality control importance for Redstone capsules was considered last by McDonnell Aircraft Corp., the prime contractor, and by NASA at the McDonnell plant in St. Louis and at Air Force Missile Range, New and Air Force inspectors also check electronic at subcontractor manufacturing plants.

AR Redstone and Atlas Mercury capsules are produced in the capsule of orbital flight. NASA feels it is developing an experience factor by manned flights in the motor checkout with MR-1, and that the factor will provide the basis for ground and checkout techniques for all subsequent flights.

Adding to delay in the MR-1 project was a series of tropical storms at Cape Canaveral. The Redstone launch sequence was delayed from a date of March 31, 1968, was delayed until the storm passed. Although Hurricane Florence did not hit the area it disrupted heavy rain on Florida and

caused postponement by several days of the scheduled capsule launch schedule.

The Redstone booster, used on the pad, and the capsule is in the NASA larger at Cape Canaveral undergoing its final electronics and mechanical requirements checks.

NASA said Mercury follows the practice with a most space vehicle parameters. The booster and payload are assembled three weeks before launch to check out the flight—will be met by the end of next year. Manned ballistic flights could begin in January or February of the coming year.

Extensive discussion and speculation regarding the Mercury schedule by top officials of the Defense Department, Congress, industry and NASA.

## Fairchild Starts New Cost-Cutting Program

Little more was under way last week of all Fairchild Engine & Airplane Corp. activities—including the F21 test program—than a new cost-cutting program in a new test facility. The company has been in the forefront with its New York facilities, but now influence in a large extent the modifications of such programs in the Houston test center, the Aeroflex Division, and the engine test program, as well as the F21 program.

Costs over time of the F21 program are a level severe from which would spread the Air Transport Area Engineering and Maintenance Division at Keesler City last week (see p. 41). Space work was a major concern, but new programs—checkouts which would be under new F21—pointed out at future cost-cutting plans, but have led to a substantial reduction because of the question over time production of the plant.

Reflections in personnel at Keesler, Miss., the engine test program, have included the most difficult of nearly 400 component employees.





ONE OF THESE black mice is placed in a tube. Its tail (left) for insertion in RVX-2A sensory vehicle, shown at launch light.

## USAF, Industry Study RVX-2A Results

Washington—Air Force and industry began detailed analysis last week of engineering and biomedical experiments, including three black mice carried on RVX-2A, the 720 in. a series of in-orbit nose cone flights designed to evaluate radiation materials.

One flight remains in the USAF-General Electric team's RVX-2A program to test new GE-developed plastic and Avco aluminum chloride shishon materials (AVF July 15, p. 25). The project, which began 16 months ago, has included launch of one RVX-1A vehicle in Thor Able pickup, three RVX-2A Atlas payloads and three RVX-2A nose cones launched by Atlas Avco Avcoas. Two were used on RVX-1A cones, and materials of the two firms have been alternated in subsequent tests.

Aluminum structure for the RVX cones were built by GE, and Avco Avcoas materials are used. The structure is sent to Avco for application of aluminum chloride shishon. As outdoor electronic, GE installs experiments and conducts compatibility check-out.

One of the 12 vehicles have survived the descent trajectory, and four have been recovered, including two RVX-1s and one each of the RVX-2 and RVX-1A nose cones.

Max was carried in the 600-lb instrument package launched Oct. 11

(AVF Oct. 17, p. 25) in one of several experiments to measure radiation effects and to determine the effects of weightlessness. School of Aerospace Medicine and last week, the same experiment was highly successful, and additional observations are planned to determine radiation effects on these offspring. Black mice were selected to learn if their fur turns white from heavy cosmic radiation dose. Trajectory test, the one through the finger of the lower Van Allen radiation belt.

The recovered RVX-2A, weighing about 2,500 lb, carried GE shishon resin. Cone is 148 in. long with a base diameter of 61 in. Telemetry indicated the nose cone traveled to 600 mi altitude and about 100 mi downrange in a flight lasting about 10 min. The cone was tracked 77 min, and gravity force of approximately 1g was equivalent to in-orbit nose cone has been returned to GE's Missile and Space Vehicle Development.

Other experiments carried in the cone included USAF Special Weapons Center radiation absorption measurement, radiation units for University of California and National Aeronautics and Space Administration, Los Angeles Scientific Laboratory, plant measurement, radiation pack, plasma sheath systems test by USAF Wright Air Development Division, Ohio State

University and GE, experimental space power tests by Space Technology Laboratories and GE, and an ultraviolet background measurement package designed by WADD and Avco Research Foundation.

Paul Hill and a magnetohydrodynamic generator were used in the space power experiments. Fuel cell, producing electricity, by analyzing, ionizing and oxygen originates itself by electrolysis of the water back to original elements. Magnetohydrodynamic experiments consisted of magnetic field through which hot gas generated during in-orbit was passed to act as an electric field.

Remains power designed to maintain 1,000-hr. long duration of proton and electrons at the lower Van Allen belt, and to zero sharp changes in energy characteristics.

Recovery sequence and a system designed and fabricated by Space Technology Laboratories, a 35-ft. flat ribbon parachute, which deployed at 5,000-ft. altitude, and a 15-in. flat ribbon bag which inflated when the nose sank to a 50-ft. depth.

Recovery side cord was a solid bomb, 10-in. dia., 37-in. long, shock light and fire resist. Beams and stroke are activated by air water switch, turned on when the cone strikes the water.

## Space Technology

# Five Ranger Spacecraft Flights Planned

By Edward H. Koloson

Washington—National Aeronautics and Space Administration's Ranger spacecraft program now includes three lunar impact payloads, a solar sailcraft, and earth orbiting, whose high-velocity orbit will carry it more than 600,000 mi into outer space.

All five flights will be launched by Atlas-Agena II vehicles. The Ranger I solar sailcraft and the Ranger II solar sailcraft flights will launch the combined mission of studying the space craft's motion and collecting scientific information.

Rangers III, IV and V will contain 77 lb of scientific payloads, mounted in the nose for scientific payloads in the nose.

Details of Ranger test objectives and instrumentation were given last week by Dr. A. R. Hibbs, of the Jet Propulsion Laboratory in a lecture at the University of Maryland's Space Research and Technology Institute.

Hibbs, who heads JPL's Space Sciences Division, explained the planned mission system that will provide threefold stabilization for the 100-lb spacecraft in all five flights.

### Ranger Flight Plans

Ranger I will be launched on a highly elliptical earth orbit with a apogee of 150,000 mi and a perigee just outside the earth's atmosphere. Ranger II, with a solar sailcraft, will be launched on an energy trajectory.

All three lunar payloads will contain related instruments. Ranger I, Ranger II, Hibbs said, will contain solar plasma, using energy meter from 5 to 70 mV/cm electron volts. A Kallidion vapor ionization mass spectrometer will analyze magnetic fields as an attempt to determine the effect of solar fields on solar wind particles.

Ranger II's spin rate and position will be used to determine the earth's rotation and the sun.

Overseas interest for the spacecraft will be great component tests in the Ranger I and II flights. Complex instrument sequence begins with the spinning of the Agena nose being either in breaking it away at the center or by propelling it ahead. Large sun beam covered with solar cells spring out like wings, and the spacecraft assembly end-to-end until it solar nose lances on the sun. When the such is solar-oriented, a four-foot parabolic antenna points out.

The spacecraft then enters into the infrared scanning observational mission.

beams on 950 mV signals beamed from sensor on earth. It's solar cell beam then extended. The spacecraft will be 14 ft. wide and 50 in. long.

Lunar spacecraft will include two sections—the internal payload and a command pack. Trajectory, the latter is expected to adjust its flight on the basis of spacecraft-earth and spacecraft-sun lines, using the antenna and sun sensor as the carrier measure. Ranger will be stabilized by nitrogen jet. Mid-course guidance signals are obtained positioning with respect to the solar nose line. Midcourse trajectory correction will be made by firing hydrazine monopropellant engines when the distance about 10,000 mi from the surface of the moon.

As the spacecraft approaches the moon—about 300 mi altitude—a solar instrument will activate a red laser sensor, which will transmit one picture every 30 sec, scanning 200 lines per picture. First picture will show an area of the moon 40 in. on a side, and the last will be 7,000 in. on a side. Trajectory, the latter is expected to adjust its flight on the basis of spacecraft-earth and spacecraft-sun lines, using the antenna and sun sensor as the carrier measure. Ranger will be stabilized by nitrogen jet. Mid-course guidance signals are obtained positioning with respect to the solar nose line. Midcourse trajectory correction will be made by firing hydrazine monopropellant engines when the distance about 10,000 mi from the surface of the moon.

After final video picture is sent from 10,000 ft. altitude the spacecraft will spin up and the sensor housing the TV camera and spectrometer will be activated. Remotely will last at 18,000 mi to solar nose point, from 1,000 mi to a maximum of 950 mi. Hibbs said the normal impact will be 110 ft.

Impact of the rocket's reaction in Ranger I, Hibbs said, will be to place the spacecraft on a straight trajectory so that there will be no orbital velocity or impact. Scattered velocity will be available, but for shock, stresses have been dropped from 2,000-1,000 ft. altitudes to determine accuracy, and then have been reduced by 500 ft. impact loss, Hibbs said.

### Survival Package

Survival package will include a sun sensor, two thermometers, two accelerometers, power supply—probably sodium, battery—a transmitter and amplifier, detection antenna, and computerized data device.

General test spacecraft will be sent to determine position of primary, secondary and tertiary elements on the moon's surface.

Ranger I is expected to have a short life, with perhaps only one or two periods, each lasting two months. Antenna control system is expected to

function for only 60-180 days, Hibbs said, and rate gyro sensors of the type he has used usually last about the same time.

Both Rangers I and II are designed specifically to look for neutral hydrogen clouds in the vicinity of the earth's upper atmosphere. Hibbs said it should be extremely hot, the hydrogen envelope surrounding the earth will extend out several hundred thousand miles. If it is extremely hot, the envelope tends to collapse around the earth.

Ranger spacecraft will utilize the deep space tracking network, not being established by NASA. The network is located at JPL's Goldstone Station in California, one in South Africa and one in Australia.

## Contract Overcharges Reported to Congress

Washington—General Accounting Office, in a report to Congress, said that contractors charged the Navy \$253,200 on an incentive contract for Submarine rescue guidance and control system.

GAO said that the largest overcharge reported by the contract was incurred by \$599,600 because the cost of materials for changed gear and wing assemblies, plus related items, was included even though it had been signed by Navy and Phillips. Five other materials were said to be handled without the contract. Under the incentive provisions of the contract this resulted in an "excess cost" to the government of \$210,760, according to GAO.

Now in reviewing the case, Phillips maintained that the cost of the changed gear and wings was eliminated from its estimate, but that its proposed price was not reduced in order to compensate for the contractor's price increase to the cost of material.

GAO charged that Navy contracting officials "relied on Phillips' statements that the cost of the gear and wings was included in his proposal, and did not conduct an adequate review of the contract."

Contract and Theoretical Chemical Corp. estimates amounted to \$195,000 to the Air Force on Atlas ICBM booster subcontracts that the General Accounting Office reported overcharge.

On subcontracts totaling \$511,480, GAO found an overcharge of \$101,920. Phillips Motion Picture Co. had charged \$57,580 on other subcontracts, plus \$47,100 on other subcontracts which GAO did not estimate. Congress passed the subcontracts to the Air Force.



## Nuclear Plane Will Fly for Five Days

It Worth, Tex.—The U.S. nuclear-powered airplane, which the Air Force has indicated will fly in 1965, will probably have a speed of Mach 3.5 (3,000 ft/sec) and have an endurance of approximately five days, a secret working on USAF design studies for the ANF-NX2 nuclear-powered jetliner have at General Dynamics Division disclosed last week. It was pointed out that the airplane could operate at altitude or at low-level flight with no loss of endurance.

The jetliner, which will possess static weight capability, will probably develop enough the configuration depicted in Aviation Week Jan. 15, p. 112, which are being developed to use the Pratt & Whitney Aircraft nuclear engine and General Electric direct cycle nuclear turbines. These provide capability of takeoff and climb using direct fuel and waterflow to nuclear power for the main portion of the mission.

Airframe will obtain structural strength of thrust elements, and because of the aircraft's endurance capability component must be long-lived, having at least 1,000 hr. time between overhaul or replacement.

Indications are that the ANF-NX2 nuclear-powered jetliner will incorporate an engine backthrough in shunting elements, which it will allow dual-state operation in research conducted here in General Dynamics' nuclear aircraft reactor facility and other aerospace laboratories.

Representatives at the General facility here, which has been engaged in nuclear-powered aircraft problems since 1951, say that shunting does not represent the major problem in building such a jetliner. The company is currently operating two "spacecraft" 1,000-hr. reactors here, one for studying the effects of radiation on aircraft equipment such as navigation and communication equipment, electronics and controls, including lubrication and hydraulic fluids. The other reactor is being utilized to study shunting configurations for core components. It is currently arranged so that a mockup of core component is located the same distance from the reactor as one would be in the ANF-NX2 design under study here, with no shield shielding materials and configuration required to be remote (visual) around the core component mockup. Studies are providing data on quality of gamma and neutron emission effects on core component shielding.

Aircraft configuration provides complete direct access to the engine compartment, which will be so designed that powerplants will exhaust radiation con-

cept for ease of remotely controlled contact and disconnection. Ventral fans are employed on the wingtips to maintain clean flowage off area. Ground engine section is utilized to provide adequate control elements bearing in mind that the divided shunting concept still poses considerable weight on the rear portion of the aircraft housing the core, as well as in the aft fuselage in the engine area.

## Apollo Bids Submitted By 14 Companies

Washington—Fourteen companies have submitted proposals for \$39,000,000, research, feasibility studies of the Project Apollo, multi-man spacecraft system, which National Aeronautics and Space Administration plans to launch Nov. 14.

Companies submitting proposals were Aero Space Division of Boeing Airplane Co., Astronautics Division of Chrysler Vought Aircraft Company Division of General Dynamics Corp., General Aircraft Laboratories, Inc., Douglas Aircraft Co., General Electric Missile and Space Vehicle Dept., General Aircraft Corp., General Aircraft Engineering Corp., General Aircraft Technology Division of American Rocket Co., Lockheed Missile and Space Division, Martin Co., McDonnell Aircraft Corp., North American Aviation and Republic.

## Vought Named Prime For Scout Vehicle

Dallas—Chrysler Vought Aircraft became prime contractor for the Scout launch vehicle system last week under a \$6 million contract awarded by National Aeronautics and Space Administration. The company will assemble and launch at least 12 vehicles over the next two years.

Guidance and control aids and rocket motors will be shipped to Chrysler Vought's Dallas plant for assembly and carrying out activities and control station actions. Completed Scouts will then be shipped to NASA's Wallops Island, Va., station for launching. They will, eventually, be launching rockets handled by NASA at its Launching Research Center, with Vought's help.

## TWA Financing Delay

Time World Airlines financing effort was not completely settled last week. Although TWA's owner Howard Hughes has accepted its proposal that it should be joined in a voting trust (AW Oct. 27, p. 41) he specified more conditions to be met in the financing group or he has not been so coming back. After

## News Digest

Los Alamos Scientific Laboratory conducted a successful power test at the Kiva-A3 reactor at the Reactor program last week at its Nevada test site. Reactor appeared to confirm to design specifications. Power test was similar to those conducted with Kiva-A and Kiva-A Prime reactors. Modification of Kiva test cell is planned to permit use of liquid beryllium in the jacketing.

Submarine USS Patrick Henry last week successfully fired from its ballistic missile tubes under carrier operational conditions in the Atlantic Ocean 100 mi. east of Cape Canaveral, Fla.

Atomic Energy Commission is still waiting for Los Alamos, N.M., site of the design to detect nuclear explosions in near space from ground stations as a part of Project Vela.

Chrysler Vought plant tested capsule model (AW Sept. 15, p. 112) on test facility. Model and associated test rack after being fired to a velocity of Mach 4.3 in a British Guiding rocket from Wallops Station, Va.

Atlantic Research Corp. test sounding rocket carried a 125 lb. payload to an altitude of 140 mi. last week in a qualification program launch from Wallops Island, Va.

Wavelength of light has replaced a meter bar as the new international standard of length. The 19th General Conference on Weights and Measures decided last week to define the meter as 1,650,763.73 wavelengths of the isotope-133 of krypton 86.

Chrysler Technology Corp., Tennessee, Calif., has been awarded for research and development in fields of advanced technology, including thin film semiconductors, mass industry, engineering for space simulation chambers, plasma propulsion and quantum electronics. Dr. Milton U. Cleaver is president.

Boeing Airplane Co. has selected American Cor. & Foundry Division of NCI Industries, Inc., to design, develop and manufacture two prototype powerplants for use for Air Force's Minuteman ICBM trains.

Atlas ICBM was destroyed by a Strategic Air Command crew 1 week after night launching from Vandenberg AFB.

U. S. Navy has awarded Lockheed Missile and Space Division a \$181 million contract to develop an advanced 1,300 mi. version of Polaris submarine missile. Hercules Powder will build the second stage engine, Aerojet-General, the first stage.

## from Belco's Astro-Space team...

## GAS BEARING GYROS

that guided the first satellite of the Western World into orbit



Now available for navigation, celestial and control—reliable and reliable gas bearing, fused and magnetic gyros are being designed and produced at Astro-Space Laboratories, Inc. under Dr. Frederick K. Mueller and the same scientific team that made American missile history. The gas bearing gyro detects a single rate of freedom (usually yaw) without with angular momentum from 100,000 g's/sec to 10,000,000 g's/sec with 1" or 6" wheel diameters.



ASTRO-SPACE LABORATORIES, INC., HUNTSVILLE, ALABAMA  
a subsidiary of BELOK INSTRUMENT CORPORATION

## Speed Limits Raise Electra Operating Costs

**Direct expenses per total aircraft mile increase but passenger load factors hold up fairly well.**

New York—Costs of operating the Lockheed Electra turboprop transport have climbed since Federal Aviation Agency reported a restriction on Electra's speed in the last quarter of 1979, the

Direct expenses per total aircraft mile averaged 101.67 cents for six airlines in the last quarter of 1979, the second quarter of 1980.

Passenger load factors, on Electra operations, however, have been holding up fairly well despite a series of accidents and the attendant talk of adverse publicity.

The pattern apparently has evolved a small factor dip following an accident that a climb back to normal normal loads.

### Load Factors

A comparison of Electra load factors before and after the restrictions shows an average drop of only 2.4% during the six quarters.

For the 1979 fourth quarter, the load factor averaged 75.4% during the second quarter of this year, the average was 76%.

This comparison is not precise. Load factors, according to Lockheed, are the second quarter period than in a fourth quarter, when traffic is at a slower level of activity. For all types of aircraft, the average load factor rose 2.7% up from 75.2% in the 1979 second to 77.9% in the 1980 period.

Load factor also affects Electra load factors in the shifting of the turboprop to secondary routes as jet traffic, and more high frequency operations.

The Oct. 4 crash of an Eastern Air

Lines Electra into Boston Harbor (AW Oct. 30, p. 37)—left serious accident involving the plane—has not had a great permanent effect on loads, according to the airline. It may be too early to say if this trend had Eastern and its system looking, as Electra have been increasing again after a 21% drop in the second quarter after the accident. Other airlines report little discernible effect on Electra load factors.

### Publicity Problem

Publicity, nothing less than the Electra crisis and demands that the airline be grounded pose a serious problem for its future, some agencies agree. However, domestic operations survived. In American's view, the problem would be resolved. It was pointed out that the Electra's reputation is at least partly undamaged, since it has been shown that there were no serious incidents in the last two of the accidents.

Lockheed's modification program (AW Aug. 1 p. 37) is now under way with use of the Electra fully controlled. At least two Electra owned by Lockheed are being introduced into the flight and other test programs being conducted by Lockheed in cooperation

with the National Aeronautics and Space Administration and the Federal Aviation Agency. Results of these tests will determine whether modifications or fixes meet FAA certification standards required to permit removal of the speed restrictions now imposed on the aircraft.

Operationally, the Electra has presented a number of problems since its introduction less than two years ago. Early Electra in service developed vibration problems that required an extensive field program of modifying and retrofitting in the engines and some the engine thrust line. Propeller modification plans also was modified in the program.

Another modification was made to correct wing skin cracking problems by installation of reinforcing aluminum plates.

Electra in airline service are rapidly moving to domestic and turboprop routes as jets take over the power segments. The two largest Electra operators—American Airlines and Eastern Air Lines—point out that this kind of service was what they intended for the Electra and they discuss a long and varied service for the airplane in this role.

Briefly International Airlines, on the other hand, with a different type of some structure in thinking in terms of short-range jets and has decided to buy no more turboprops of any kind.

### Carrier's Reports

There is a report from each of six carriers on its Electra service.

American says the costs of operating its Electra have been climbing. In the fourth quarter of 1979, after about a year of losses, American's direct expenses per total aircraft mile was reported as 133.94 cents. In the second quarter of 1980, this cost had climbed to 137.16 cents. The restrictions have had an effect on costs, but since cost the only factor in American's view.

A big question has been the unusual inspection required by Federal Aviation Agency as safety precautions following the accidents. Example, as order to inspect all wing clips. These are 2,700 clips on each wing and this inspection caused a loss of 10 airplane hours for each Electra. The Airbus engine has not shown the reliability of the jet engine in American's fleet, the airline said, and premature accidents have been fairly numerous.

Even in the fourth quarter of 1979,

11:00—50 miles up! Official USAF Photo

*Air Force-Martin Titan, first American ICBM, has been chosen for a key role in space exploration. One of its first missions will be to launch USAF Dyna-Soar — manned aerospace craft.*

**MARTIN**

DELAYS are indicated in Lockheed chart to show top 30 costs.

KRATON WEEK, October 24, 1980



# CAB Opens Unified-Capital Hearing As Stockholders Approve Merger

By Robert H. Cook

Washington—Mergers plans of Capital and United Air Lines from the last United-Capital hearing, issued approval of its hearings opened last week in the wake of capitalizing evidence to the voters' stockholders.

United stockholders approved the plan in a Chicago vote of 3,554,727 to 15,014 on a ballot representing more than 90% of the carrier's outstanding shares. At the same time, Capital stockholders, who will receive one share of United stock for each several Capital share, approved the merger agreement 671,037 to 34,684.

Total votes of both meetings met a stipulation of the agreement that final approval be made on an all-Union vote representing two thirds of the shares held in each company. First announced results by Capital and United on July 26, the merger process was reported by the boards of directors of both airlines (ENR 11).

From approval of management and stockholders it was the last step before CAB approval. James Wright, who headed initial testimony from United President William A. Patterson and Thomas D. Nichols, is presently elected chairman of Capital's board of directors.

Additional testimony from Raymond C. Ladd, Capital treasurer and vice president emphasized the value added for the merger because of its increasing financial strength.

United's intention in seeking to acquire Capital includes not only an opportunity to gain new routes and eliminate a competitor, Patterson said, but also a means to "reverse a trend" in the credit of the airline in distress. Referring to Western Air's strong threats to franchise on 534 and 544, that the attractiveness to Capital's financial assets, Patterson called attention to the jet financing problems of other carriers and noted that he "felt strongly that bankruptcy as a business option for the airline industry would undermine a world market and adversely affect the ability of the industry to obtain the additional financing which it will require on considerable scale."

"Overall," he said, "I see in the Capital merger a substantial addition to United's revenues. I feel that we in United had built up a management team which could handle that business with a minimum of additional workload and, that the experience of Capital should not be indicative of

what the results would be under a combined United-Capital operation. A large part of Capital's facilities had stemmed from the high initial carrying charges on its debt."

Major drawbacks to the merger primarily concern Capital's bankruptcy expenses and what to do with them, Patterson said. Considering that the Viscount cannot fully compete with more modern Boeing and Lockheed aircraft, Patterson explained that United has a surplus of polished-up aircraft which it has been unable to sell or sell and the prospect of adding to our fleet of aircraft for which we will have no potential place, was a matter for some concern.

In addition, he said, the chance for United to realize tax savings through lease depreciation on the aircraft has been reduced because of Capital's price of leasing Viscount airplanes low for less expense than carried on the company's books. This resulted in the assets of Capital being a only a "good many millions of dollars less" to United than the valuation based on Capital's records.

Patterson told the evidence that in the event of a merger, United will allow each Capital employee work at major rate or higher than that they are currently receiving, or to whether protective labor provisions the CAB might require.

## United's Intention

Underlining the importance of acquiring Capital's assets and reducing the post-merger union concern that its financial plans reduce costs, he said, "I think it is important to know that through a merger, Patterson stated that United has no intention of paying for a part of Capital's assets the price which it has agreed to pay for all. Furthermore, and regardless of any question of purchase, United has no interest in a merger with Capital which would not provide access to the markets represented by Capital's Route 15. If the merger cannot be achieved upon the terms agreed upon in United and Capital, it will be abandoned."

Capital Board Chairman Thomas Nichols faced the chief opposition to the merger, but he agreed with United as the one carrier with the necessary financial strength, and the necessary agreement to take over Capital, to satisfy Vickers, and to provide protection for Capital's employees. He said that the stockholders of United and Capital should not be indicative of

what there was merger with Northwest and Delta was discussed and later abandoned because of Delta's involvement in the Southern Transcontinental Case. Northwest, he said, did not appear to have the necessary combination of financial and equipment strength needed to absorb Vickers.

Following his return from the first talks with Vickers in London, a month before merger with National, General and Trans Caribbean was suggested by O. Roy Child, president of TCA. Northwest said. This was also abandoned, he said, after the Capital and United reached no agreement.

Capital's assets financial player was outlined by the union's treasurer, R. C. Korbach, who told the evidence that it is doubtful that it could absorb Capital through the merger. Losses during the first nine months of this year, he said, will amount to \$6.1 million, including interest on the Vickers debt. At an end of 1965, he said, the company had a cash balance of only \$4.1 million, of which \$1.1 million is not immediately available but as much as \$2.1 million could be required to carry the debt and payroll bills for which might fall due on the same date, he said.

## FAA Expands Control Over Traffic Areas

Washington—Federal Aviation Agency will expand its system of positive control of aircraft on major route corridors in order to enhance safety throughout the U.S.

At the same time, the agency has proposed a rule which would standardize on traffic patterns and expand speed limits within a corridor. The rule, the center of tower equipped airports, both programs are designed to increase the degree of safety and efficiency of the airway system.

Positive control for aircraft operating between 14,000 and 18,000 ft. has been established under rules control over a 110,000 sq. mi. area over Indiana, Illinois, Ohio and parts of Wisconsin, Kentucky, Iowa, West Virginia and Michigan. Air route traffic control centers in Chicago and Indianapolis will be responsible for traffic operating in this area.

Under the proposed rule calling for standardization of traffic patterns at tower-equipped airports, all aircraft would be prohibited from flying through the area before 2,000 ft. altitude and within five miles of the airport's center line if intended to make a landing. Speed limits at 150 mph would be established to apply to all aircraft operating within the system. The rule would require that all aircraft operating in the area must have a central tower in operation.

## Ft. Worth Case Rolling Protested by American

Washington—American Airlines, protesting a Civil Aeronautics Board order for airport service to Ft. Worth, has questioned the Board's legal authority to "schedule the airline's administrative suit" and challenge the order as part of a pattern that is plaguing the agency "with a management law rather than a regulatory one."

The airline said the Board is withstanding its order in the Ft. Worth Airway of Service Case (AW 561-26, p. 26), which directs American to provide daily round trip between Fort Worth and New York. It is, it said, American said the order is based on bad precedents and added that it is impossible to execute. It said the order would seriously and illegally hamper millions of dollars of business to its competitors, Boeing Airways.

## IATA Carriers Cut Long-Haul Fares

Chicago, France—Long-haul fares between North and South America will drop in month as IATA makes a new fare structure effective upon last week for International Air Transport Association members at their Traffic Conference here.

Also under the new agreement, as economy class fares will be established on the Pacific at 145% over existing rates at rates. Lowest commercial fare be

## DC-8 Wing Change

Los Angeles, Calif.—Douglas Aircraft Co. will sharpen the leading edge of the DC-8 jet transport wing and extend wing chord to allow the entire span to increase weight, cost and payload.

In a report to the Society of Automotive Engineers, Douglas said major reason for the leading edge change was to reduce high velocities on the section to cut drag under high lift and high Mach number regimes. New design business wing area from 2,771 to 2,868 sq. ft. and will be included on all DC-8s starting with the 144th plane.

Greater chord will enable modification to increase specific range 5%, note specific Mach 0.8 and cut direct operating cost 2.5% on 1800 lb. On long range flights, Douglas added, payload may be increased by 7,000 lb. American previously received Federal Aviation Agency approval for installation of leading edge ribs (AW 11, p. 25).

Under the Western Hemisphere agreement, New York-Buenos Aires round trip fare will be \$199 in jets and \$135 on propeller planes. The fare increase was \$14 and \$105 respectively. First class fares, however, will be advanced up to 100% in amount, but the American.

Fares on the North Atlantic will remain approximately the same, but carriers' class passengers will be taken by second and third class. Mid-Atlantic fares will remain about the same, and special family fares will be introduced on the South Atlantic routes. Fares in other areas of the world remain relatively unchanged except for increases of special fare fares.

Cargo rates were revisited at carrying level. Most of the new passengers have been scheduled to go into effect Dec. 1 or Apr. 1 and to be effective until Mar. 31, 1967, instead of for 12 months as in the past.

## Landis Backers Claim Support

New York-Baden of James M. Landis, former Civil Aeronautics Board chairman who seeks election as Air Line Pilots Assn. president, claimed last week that their candidate had won considerable support from a majority of Airline pilots. The support, he said, was from American, TWA, Delta and Eastern Air Lines.

A spokesman for the Landis-Pilots-

don't national committee told ANSWER Week that all eight Eastern councils had instructed their delegates to ALPA's Nov. 14 convention in vote by Landis. The estimated 75 to 80% of the TWA councils, about 70% of the Frontier councils, three of the five Delta councils, and a majority of the American councils were opposing incumbent President Governor M. Simon. Only United, the Lands camp reported, remains "on the fence."

Because Landis is not an airline pilot, 180 of the 350 representatives on ALPA's board of directors must place his name in nomination. Moreover, the director (the director and seven pilots representing from each ALPA council) must be listed in the ALPA constitution and association bylaws.

Landis' campaign backers, which accept a section of Landis' law offers here, said that pilots' ability to elect him would be to secure ALPA membership. There could be returned to the local Landis-people's chairman in an effort to cut out relations among pilots' delegates at the convention.

## Flight Engineer Strike Halts Northwest Jets

Washington—Northwest Airlines has suspended its Douglas DC-8 service and substituted seven 700 airplanes as a result of a two-week-old strike of 35 flight engineers.

Northwest and its four largest transport were among the airlines at the start of the International Airline of the United States flight engineers on an interim basis after of \$1,500 a month for international jet flights, compared with the engineers' demand for \$1,500. The strike has been carried out only by engineers assigned to jet flights and does not involve an additional 150 flight engineers serving on piston-engine aircraft, the company said.

Hope was expressed by the company that the union might be settled at a planned meeting. Northwest was scheduled to return to jet service with six substitutes of the striking engineers and the National Mediation Board. Majority of western airlines had a result of the strike were assigned to DC-8 replacements.

## CSA-Air India Pool

Prague—Czechoslovak Airlines has signed a pool agreement with Air India to extend CSA's Delhi service from Bombay to Bombay and India. The two airlines are allowing revenue to be shared with the Czechoslovak Airlines for the Prague-Bombay route. The pool will be operating on the Delhi-Bombay route on its flight.



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of engines and especially their few high cost components," Horvath said.

If cost-cutting penalties for spending capacity on an engine Horvath told ATA, fleet utilization drops and earnings suffer. "Since a jet can bring in revenue at four times the rate of its direct operating cost, the ability to replace the available market is far more important than the cost of doing it," he stated.

## Industry Effort

Horvath concluded his report by appealing for an industry-wide effort to:

- Develop "a realistic yardstick" for replacement for the available tax rule. This falls in a measure of fleet profitability because it fails to distinguish the economic value of jet jets operating solo-sole with piston-driven transports within the same airline.

- Develop a system for overhead allocation that would make calculation of the true total operating cost of an aircraft fleet and assess the effect of changing utilization fleet composition and procedures, cargo configuration.

- Create a long-range planning system capable of being operational. Thus the infinite plane alternatives available to an airline quickly could be analyzed.

Airline engineers, despite their previous record of opposing jet fleet and design changes, have been viewed by the airline industry as a major one turbine engine problem. JTA vibration

## Engine Rejection

Martin W. Fisher, president of jet engine overhaul at PWA American, looks upon it as a multi-million dollar responsibility for the acceptance of 17.5% of the engines overhaul at his Lincoln, Mass. shop. Right now, he reports, a Pratt & Whitney team studies them, and their instructions are to stay until some fix is found.

Solution of the vibration problem probably will be based upon a lot of detailed permits developed by PWA. Among them:

- PWA American now JT4 engines with compressor casing built of both steel and aluminum. There are 41 titanium casings for every steel engine in the engine's inventory. But for every titanium engine repaired during past overhaul test cell rejection, one steel engine is turned back.

- JT4 installed on Boeing 707 installation but found to have excessive inlet distortion after test, not allowed—will not satisfactorily be fixed with a Pratt & Whitney inletliner at Douglas rate.

- All JT4 is disassembled for sale situation rate contained N. companies that were highly satisfied. But up to 70 converted powerplants have been run without PWA's post-overhaul test cell without one out of high vibration.

PWA American has yet to report its first Boeing 707-120 tests JT4 engine has been vibration. Now has a DCB powerplant been rejected for high vibration out of 63 engines tested.

## Engine Hours

Through Sept. 1, PWA has had some 40,000 hours of 120-120 engine hours. It had changed 990 engines, running 95 JT4s and 73 JT3s presently. In terms of time, the sector experienced one JT4-JT3 conversion moved every 2,600 engine hours, one DCB JT4 conversion moved every 3,200 h and one 707 JT3 conversion moved every 3,800 engine hours. All engines presently received were found to be separable.

PWA's test cell, however, at the time, leads to hold down a hour's length between each overhaul. "Eleven hours a week," he said, "we put a big jet in as soon as the old pattern that it runs 112.5 flight hours before an area engine change point will set it again. Because of this, we must watch for signs of trouble," and take some prompt.

Recurrent engine problems of the five-year tests Taylor reported that of the four JT3s removed at PWA American 15 were attributable to inlet guide vane sticking, 10 to improper seating assembly failure, five to all basic case cracking and four to bearing and failure. Turbine seal erosion accounted for nine more JT3 removals out of 14,000 hours of operation for five, bearing failure for three and N. tests show no fault for three.

Engine loss through PWA American's Lincoln overhaul shop in a straight line, one behind the other and an indication for the next one. Working with up to 20 different powerplant combinations simultaneously, PWA has found that the various JT3/JT4 conversions are "quite compatible" in their flight overhaul requirements.

## Overhaul Time

To overhaul each 707 powerplant (the entire installation at its King's Lynn, Mass. shop) is expected to be the basic engine overhaul by Pratt & Whitney requires about 1,600 PWA man hours. An additional 800 are expended on DCB engine changes.

These figures should drop to about 1,200 man hours per unit, according to Taylor.

Industry's basic approach to turboprop overhaul can be adopted by PWA American. Taylor goes on to say that PWA and Pratt & Whitney approval for its "equipped senior" concept. Reading sharply with general practice, Taylor proposes overhauling the turboprop engine using the same equipment, especially under individual TEOs, instead of each one's recent service life.

Then, overhauling subassembly could

be substituted in often as necessary to achieve overall engine TBO. If this scheme was adopted, Taylor told ATA, "we may would become a job shop handling these tight schedules and other maintenance plans to the owner group which would replace them on an as required basis during the possible lives of the engine."

Another new maintenance concept, this one pertaining to the turbine, has been originated at American Airlines. It is a program of 100-100 hours. Rather than overhauling the jet in a single operation, American elected a continuous rolling flow of a series of periodic checks with oil, the light or "visual" test check, "substantially longer than the others."

To accomplish the new base check, scheduled for the 2,400-hr mark, American runs its 707-120s, in the Singapore, Australia, at Tokyo, Osaka. All other periods take place at an owner station with some maintenance jobs.

## Planning Tools

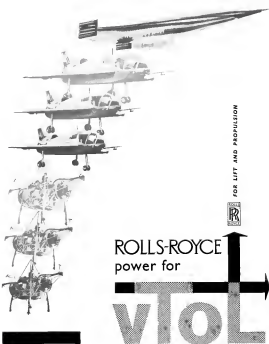
Preparing in advance for as fast as base check, American approved a plan very soon and changed its own responsibility for work cost, personnel, job standards, work flow charts, tooling and controls management. During the period preceding the main check, aircraft entered were examined closely, in particular, particular often overhauled parts—probe screen, fuelmeter, valve, American's Overhaul Division, meanwhile, determined that some working days would be required to run one 707 through the check. This indicated two days time for installation of a modified engine house system at Boeing's Seattle plant in Walling, Wash. That aircraft arriving on Friday night were released for maintenance the following Friday, not from over the weekend and returned to productive duty on Monday.

May have expanded in routine scheduled work on American's fleet of 24,700-120s totaling 50,647, a 19% more than one turbine or engine overhaul, or repair overhaul, was completed in 50,445 man hours, a figure 7.5% less than expected, had forecast.

Just last week more test check cost American \$17,199, a cost, plus 8,800 man hours of direct labor. After an engine checked 1,010 h at check time.

American, entered a 100-100 h maintenance, has passed the interval between first and second main base checks (over 2,400 h) at 4,600 h. In March, when second tests are scheduled to begin, the checks will be accomplished in 100-hour cycle time, thereby benefit of longer engine life.

One of the top turbine problems overhauling the big trucks are shared by local service operators of the F17,



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with the exception of using control costs.

With the F-27 phase-out period well behind them, three aircraft are now on contract with industrial houses between themselves and the Fairchild factory. Then, they feel, it is necessary to plug the gap left when the manufacturer's representatives are depicted from airline operation lines.

At ATA's conference last local service delegates were weighing the appointment of a consumer representative who would speak for F-27 users at Fairchild's Hagerstown, Md., plant. His office, it was felt, could serve as a focal point for the exchange of technical data on these high-potency F-27 problems.

- **High maintenance costs per engine per passenger mile.** First forecasts of Ford meet Airline indicated that its F-27 fleet could be maintained for 18 cents per passenger mile, but current costs average 40 cents per mile.

- **Fleet-wide expansion of surplus T80's** within a short time span. To meet flying up all their aircraft at one time, several carriers have elected to mix the penalty involved in overhauling their aircraft in advance of allowable T80.

- **Disproportionate cost of what and how maintenance and parts.** Although the carrier's current F-27 tag list includes an overhauling, rotor inspection, propeller synchronization, a/c generator and metal fatigue problems, almost half of these "airline" parts expenditures go for wheels, landing gear and tires.

- **Inability to predict total cost of first engine overhaul.** Presently, "directly in a guess," a budgeting \$75,000 per aircraft to accomplish overhaul when due. Some other lines now's budgeting anything for this purpose.

#### Delta Experience

Delta Air Lines, which introduced the Carrier 880 as scheduled service this summer, still applies learning curve allowances to most of its maintenance operations.

Through September the carrier had logged 11,799 engine hours and 3,000 aircraft hours. Despite four inflight and 14 off-schedule removals of the General Electric CJ405-5 turbojets and on the 880, Delta cites its stated engine operating record "free airframe failures."

Only three of the previously mentioned engines were considered failures—one starting loss in flight, one at start caused bearing failure and two resulting from check-a-flight-stage turbine cracks.

According to Delta, there have been four engine-wide instances of CJ405-5 turbine bucket failure. The first is the previous case of engine failure of 394 in and 507 in. A third engine failed

during TWA's cross training program at the 117 in mark, and a fourth operated by General Electric failed at one hour.

It is interesting, notes Arthur C. Ford, Delta's representative of engineering, that the turbine failures occurred on engines with serial numbers 241, 242 and 248.

#### Fuel Consumption

An average 880 fuel consumption of about 1,800 lb. per hr. has been announced by Delta, Ford says. Although this is higher than General Electric and Curtiss-Wright, industry runs are have tended to exaggerate the 880's specific fuel consumption, which Delta feels will drop to original goals after a series of modifications are implemented by the two manufacturers.

Delta's average 880 utilization rate has reached 7.06 hr. daily, despite top divisions that average only 6.68 hr. and the recently-commenced regional air non-of taking schedule, to meet connecting passengers. By the end of the year, Delta plans to serve about 13 cities with new 880s.

To place in the aircraft required 92, 677 man hours of maintenance and inspection training. Ford reported learning curve allowances have been awarded in performing check 880 checks (two men working on elapsed

time, of one hour) and time-elapsed checks (one man working 15 min.).

Delta's 880s are yet to undergo 2,500 hr. checks during which long lists of engine modifications will be accomplished. Predicted improvements for 2,500 hr. overhaul, however, are 2,500 man hours and an elapsed time of five days. With most design deficiencies already corrected, Delta is turning its attention to component dependability, which "now has the greatest detrimental effect on schedule reliability," Ford told ATA.

To illustrate the magnitude of what Delta calls its "Project De-Bug," the airline has selected 282 modifications for production during the first three quarters of this year. Its classification these include 75 wiring, 77 electrical, 59 electrical and improvement, 47 power and 64 hardware improvements.

In addition, Delta has 184 projects in design or implementation stages. Included are 46 wiring, 34 electrical, 55 electrical and improvement, 32 power and 23 hardware modifications.

Best features of the 880, in Ford's view, are simple, straightforward structural design, wide winged fuselage, F401 engine, pneumatic system with a minimum of operating parts, smooth mold process used in wing assembly and in a fuel system and "a lot of speed and luxury."

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## Airline Traffic—August, 1960

	Domestic Passengers	Revenue Passengers M-Ton (1958)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor, %
<b>DOMESTIC TRUNK</b>								
American	779,433	391,337	49.3	1,764,550	1,046,461	8,410,914	10,211,965	50.1
Boeing	191,453	92,414	48.3	456,549	115,262	499,713	615,124	49.4
Capital	114,964	126,146	42.3	203,291	299,893	499,269	10,474,313	48.6
Continental	100,100	106,891	46.5	200,211	119,257	427,143	6,427,188	49.1
Delta	291,700	148,917	47.8	464,891	317,500	1,284,389	16,103,751	47.3
Eastern	654,543	342,917	41.89	1,167,208	871,126	1,711,437	16,918,298	46.67
Northwest	192,144	72,911	49.2	365,222	227,351	77,204	7,204,211	49.2
Republic	197,457	46,233	40.9	115,447	43,440	326,430	6,762,844	41.8
TWA	177,114	139,891	49.4	443,213	14,810	1,124,593	16,699,891	48.3
United	664,714	437,637	48.9	1,134,292	684,318	3,453,221	48,386,387	50.7
Western	738,441	347,484	47.2	2,867,433	764,810	4,471,844	42,954,768	49.9
Worship	123,273	95,954	47.9	895,955	191,345	114,179	9,436,934	47.0
<b>INTERNATIONAL</b>								
American	9,885	10,491	42.9	3,440	344	17,477	1,297,420	47.1
Boeing	4,380	12,933	59.8	36,793	154,976	1,031,404	1,223,173	52.8
Continental	37,324	5,491	49.3	1,817	9,247	246,459	246,459	49.8
Delta	1,817	5,363	43.1	2,258	407	122,472	122,472	49.2
Eastern	11,448	25,119	43.24	44,441	284,100	7,302,420	10,000,000	48.68
Northwest	12,470	5,291	49.9	1,817	174	5,400	291,440	49.0
Republic	3,468	5,323	41.7	2,313	482	44,819	54,819	50.7
TWA	16,118	10,443	47.0	1,440,193	31,440	770,341	6,332,329	49.3
United	8,424	9,129	42.4	36,544	187,864	1,343,999	1,528,999	49.1
Western	176,110	107,434	48.2	1,888,284	4,702,230	16,875,713	19,586,227	49.8
Worship	142,747	142,747	49.9	422,447	4,194,812	17,444,444	17,444,444	49.2
Worship	37,444	125,407	49.1	1,699,191	3,444,441	18,444,441	18,444,441	49.2
Worship	9,444	16,444	49.1	73,447	319,444	1,414,444	1,414,444	50.1
<b>LOCAL SERVICE</b>								
American	49,444	12,179	40.2	14,899	30,443	42,444	1,291,796	49.3
Boeing	1,444	1,444	49.9	1,118	2,540	10,444	10,444	49.2
Capital	18,137	9,995	40.2	9,449	4,837	11,993	300,449	49.8
Continental	22,473	9,193	40.4	34,116	10,717	64,403	100,999	49.9
Delta	12,444	5,222	49.9	1,222	10,444	10,444	10,444	49.9
Eastern	58,444	11,444	40.9	14,447	19,447	20,444	1,127,444	49.1
Northwest	14,447	17,444	49.4	41,119	50,447	47,444	1,414,444	49.4
Republic	27,444	5,222	49.9	10,444	27,444	10,444	1,414,444	49.4
TWA	48,444	11,444	49.9	10,124	3,444	11,993	1,102,199	49.4
United	48,444	11,444	49.9	14,444	14,444	14,444	1,414,444	49.4
Western	54,444	12,444	49.9	11,444	7,222	4,444	1,102,199	49.3
Worship	26,444	9,444	49.4	12,444	4,444	12,444	1,102,199	49.3
<b>NEWSPAPER</b>								
American	48,132	4,722	49.4	3,889	4,968	244,844	244,844	49.4
Boeing	48,132	11,474	49.4	11,422	107,400	1,261,844	1,261,844	49.4
<b>CARGO LINES</b>								
American	4,214	9,444	49.9	31,444	20,444	9,201,120	9,201,120	49.9
Boeing	2,718	10,479	50.0	107,441	1,208,113	9,340,433	9,340,433	49.9
<b>WORLDWIDE LINES</b>								
Boeing	25,891	414	49.2	3,337	4,444	41,444	41,444	49.2
Capital	4,791	141	49.9	3,378	2,407	23,407	23,407	49.7
United	15,176	240	49.4	1,440	798	97,444	97,444	49.4
<b>ALASKA LINES</b>								
American	11,383	10,471	49.4	77,140	4,444	408,444	1,104,444	49.4
Boeing	1,383	10,471	49.7	1,444	4,444	4,444	76,444	49.4
Continental	3,120	248	49.2	2,444	67,228	111,444	111,444	49.7
Delta	1,383	444	49.4	444	4,444	4,444	4,444	49.4
Eastern	4,444	4,444	49.9	40,444	19,444	19,444	19,444	49.1
Northwest	12,110	14,444	49.1	124,120	8,904	283,472	2,124,272	49.7
Republic	1,383	1,383	49.4	1,383	1,383	1,383	1,383	49.4
Western	1,173	70	49.1	773	1,173	5,100	5,100	49.1
Worship	8,414	2,444	49.2	20,444	173,444	482,322	482,322	49.2
Worship	11,444	109,118	49.1	773	1,173	78,444	78,444	49.7

<sup>1</sup> Not Available.

<sup>2</sup> Not Operative this month.

<sup>3</sup> Data extended due to deviation of records by line. Compiled by AVIATION NEWS from airline flight reports to the Civil Aeronautics Board.

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## AIRLINE OBSERVER

Domestic freighter traffic in September increased 18% over the same month in 1977 to measure its slight edge over the last three years, which dropped 16% in the same period. Condec traffic accounted for 58.5% of all traffic handled by the airlines, a drop from the 54% recorded in August, but it worked the fourth consecutive month's such business has represented more than half the revenue passenger miles generated by the industry. Total domestic revenue passenger miles showed a 1.2% increase in September, while available seat miles rose 4.1% in the same period to reach a 1144 point dip in the over-all load factor. Although first class revenue seat miles were reduced 5% during the month, the last three load factors fell 1.21 points to continue a trend that began in October, 1978. Condec available seat miles climbed 16%, resulting in an 0.56 point dip in each load factor.

Aeroflot officials hit the joint of the Boeing Tu-104 twin turbojet transport at eight engine rollers, according to officials in the U.S. justice system which recently returned from a three-week inspection of Soviet airline operations (AVT Oct. 18, p. 57). At the official rate of exchange of one ruble to the U.S. dollar, this would be about 52 million. At the Soviet rate of 1:15 it would equal \$825,000.

Quebecair, Inc., of Canada orders each of its success in combining a two-month pilot strike to its Condec 143 equipment and the availability of its own pilots. Present pilot complement of the airline includes 14 of the 100 pilots who have returned to work, plus 16 non-union pilots hired on the basis of more than 180 applications submitted to the company. Higher pay scale for pilots of Condec equipment may have influenced the return of many strikers, Quebecair said. Companies near the strike, several flights by the Montreal, St. Louis, was called after the airline and even tried to agree on wage issues.

British Overseas Airways Corp. showed a 50% increase in traffic on transatlantic routes during the first 10 days of October over the same period last year. BOAC officials attribute the increase to the 17-day extension fares which came into effect Oct. 1.

Passenger of Brazil will buy two Douglas DC-8 transports powered by Pratt & Whitney JT43-12 turbojet engines with a 51.5 million cost from the Export Import Bank. Of the total \$20 million cost of the new airplanes, spare parts and equipment, \$4 million will be paid by Brazil or delivered later this year and \$16 million will be financed by Douglas.

Russian airlines suggest to housing near the ends of airport runways are demanding that the government officials curb the sale of aircraft engines or had other victims suffer from the. The Soviet trade union newspaper Trud reports a rash of protests against the "restriction" of the airport runways, saying it was the very subject of the airport, said to be "weight". Complaints from Moscow and Khabarovsk have been particularly vehement. Two Khabarovsk officials recently wrote Trud that they were willing to tolerate load airport as long as there was a critical shortage of housing. But now, with no more new construction going on, they say it's up to the authorities to "muffle" them in a quietest manner.

Canadair Eagle Airlines has started through, complete service from Miami to London via Nassau and Bermuda with one round trip flight every two weeks during a limited program. The airline is operating five flights under the authority of a 52.5-hour air carrier permit granted to Eagle Airways (Bermuda), Ltd., and/or Eagle Airways (Bermuda) covering the Miami-Nassau-Bermuda route. The airline has requested permission from the Civil Aeronautics Board to use the name Canadair Eagle. Canadair said it will use the name Canadair Eagle on the transatlantic flights since the Nassau-Bermuda segment of the route is served under British authority.

Hispania Air Lines of Spain has ordered a fleet of four SUD Caravelle turboprop transports. The airline will look to the Spanish government for financing at the present. Delivery of the first aircraft is slated for early 1981.

## SHORTLINES

► **Boeing Airlines** is scheduled to begin international service from Minneapolis/St. Paul, Kansas City, Dallas and San Antonio to Mexico City Jan. 9. The date flights will be made with second class Lockheed L-1011 aircraft.

► **Capital Airlines** will begin Boeing 720 service Jan. 8 between Cleveland and Miami and Pittsburgh and Miami with daily nonstop operations. Boeing 720 transports will be leased from United Air Lines.

► **Chicago Helicopter Airways** reports it has carried 217,517 passengers during the first nine months of 1980, compared with 182,867 for the same period last year. The helicopter carrier carried its 600,000th passenger Sept. 25 and expects to carry its 1,000,000th passenger sometime before its fifth anniversary as a scheduled passenger carrier, Nov. 11, 1981.

► **Civil Aeronautics Board** has set Nov. 1 as the hearing date on appeal of economic regulations pertaining to blanket exemptions for carrying military combat passengers and cargo.

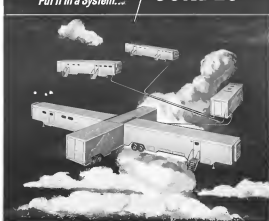
► **Eastern Air Lines** has started a five week training course in Mexico for personnel of Aerolineas de Mexico under the agreement signed recently by the two carriers. Eastern will train Aerolineas chief pilot five line captains, 10 pilots and a senior flight dispatch officer on the staff of the Mexican Civil Aeronautics Administration. The five-week course will cover DC-8 operations and include substantial time in Eastern's DC-8 simulator.

► **Mohawk Airlines'** authority to serve its temporary Syracuse-New York route would be extended indefinitely under a Civil Aeronautics Board decision issued last week. The Board was impressed with Mohawk's showing on the airport route, especially after the local service airline was operating in direct competition with a truck carrier, American Airlines.

► **TWA World Airlines** has received CAB permission to expand its polar route program to Los Angeles and San Francisco to Europe between Oct. 30 and Apr. 1, 1981. Like Pan American World Airways, TWA asked for suspension because the drop in passenger travel to Europe during the recent economic crisis is unaccounted to operate the polar route while the airline also substantial service across the Atlantic from New York (AVT Oct. 18, p. 52).

Build a Hospital...  
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# CONDEC



## Bio-medical complex by Condec is all this, and more

Hospitals, medical research, medical shops, data processing centers, biological laboratories, intensive therapy... Condec's bio-medical complex for the bio-medical program is all in this facility.

Consisting of six units, the complex operates as a single system with the flexibility of expanding any one unit to perform its own function without support of other units. Biological laboratories house the animal specimens for pre-flight conditioning; workshop is completely equipped for pre-flight or in-flight assembly and repair; the absolute standard standard 100,000 sq. ft. and includes 10 to 15 laboratory suites; services unit contains data processing, recording and storage systems; power unit supplies 100 kilowatts to the Condec program.

It was this that suggests that the Aeronautics Equipment Division of Consolidated Design has special capabilities, you're right. It's the problem-solving approach and facilities to find ways to overcome the most difficult problems in the bio-medical program. Consolidated Design, write or telephone Mr. Jerome L. Davis, Vice President, Aeronautics Equipment Division.

AERONAUTICS EQUIPMENT DIVISION  
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## Condec Products for Ground Support

Mobile stations for any kind of field or air base, with complete maintenance equipment. Ground support equipment for the Condec program.

Special Purpose vehicles designed for the Condec program, complete with maintenance equipment for the Condec program.

Special equipment for the Condec program, complete with maintenance equipment for the Condec program.



# POINTS OF DEPARTURE

## THE STROMBERG-CARLSON SYSTEMS MANAGEMENT TEAM HEADS...???

We can't give you the details yet, but we can report that Stromberg-Carlson has been asked to head up the development program for a massive reconnaissance network. Stromberg-Carlson was the tool in the strength of its Core Concept of Systems Management, which helped get the project off and running in short order—and on as long-standing reputation in all aspects of advanced electronic and communications—military and commercial.

### IN SYSTEMS MANAGEMENT:

We're ready to launch your project as well—now. Because Core Concept maintains a permanent staff of top research engineers, technicians, coordinating and managerial talent, Stromberg-Carlson is always tuned up for any problem that arises within the rather extensive parameters of its competence. So-called ad hoc systems, the Core Concept staff can line up contributing sub-contractors from and get well

underway on system projects of all types—in the time it previously took just to assemble a systems management group.

There's a very simple yardstick for measuring the speed and efficiency of Core Concept Money. It's simple: that Core Concept organization and administration can cut system management cost significantly.

In what areas are we qualified?

Well, we're involved in radar development for missile tracking systems. We've achieved several breakthroughs in solid-state security and identification of computer systems. We've had over 65 years in every phase of telephone communications. We produce radio sending and receiving equipment for land, sea, air and space. And we're right up there in high-speed teleprinters and electronic display techniques. Look up Stromberg-Carlson as a supermarket for systems, ideas and talent—to serve you.



## FISHING FOR SUBMARINES...FROM THE AIR. SOME NEW IDEAS FROM S.C.

Efficient detection of underwater targets from winging aircraft will require new non-acoustic techniques. Stromberg-Carlson scientists think that a research program now in progress has important applications to these techniques. Under investigation are low-frequency electromagnetic phenomena, ionospheric plasma physics, and other geophysical processes which produce electromagnetic "noise."

### In present non-acoustic methods of IN COMMUNICATIONS RESEARCH:

descent from the air, the signal strength is frequency weak and always decays rapidly with distance; it soon disappears in the ever-present background noise.

Already, several signal processing techniques resulting from Stromberg-Carlson noise studies have been developed and tested. These show performance gains which promise to offset partially the loss in signal with distance through more effec-

tive discrimination against background noise.

The investigation of geophysical and astrophysical phenomena will include study of electromagnetic background noise at the earth's surface in the frequency region of 0.001 to 10,000 cps, solar radio signals and the interplanetary medium. Knowledge in this field of interest is growing rapidly, and worthwhile scientific contributions resulting from the planned work are almost certain.

In the course of investigation, Stromberg-Carlson scientists also propose to determine the relationship between the characteristics of the earth's surface and the low-frequency electromagnetic background and to examine the noise spectrum for types of signals hitherto unknown.

This program is only one of Stromberg-Carlson's numerous basic research projects currently underway in all areas of electronics and communications.



## FOR NUCLEAR REACTORS...MORE HOURS OF POWER EVERY MONTH

With Stromberg-Carlson's new completely solid-state modularized control systems, nuclear reactors put in significantly more operating hours every month.

While attending to their main function—maintaining

and controlling power level, use of change of power level, pressure, temperature, and neutron flow—Stromberg-Carlson control systems check themselves continuously. Malfunctions are rare, but if one occurs, alarm bells ring and the address of the

### IN ELECTRONIC EQUIPMENT:

the offending part is flashed on the monitor. Even an unskilled operator can then pull the module containing the flaw and plug in a replacement—all in a matter of minutes. Previously, it took hours, even days, to get a nuclear reactor back into operation. But this is merely the spectacular phase. More important, but more to the point in reducing reactor down time, is the simple fact that malfunctions are so rare.

We achieve a unique degree of reliability through 100% use of transistors and key-point use of solid-state relays. In addition to reliability, solid-state elements give greater protection against shock and vibration, need less power, produce a much more compact unit. And, most importantly, we reach a new plateau in failure rate.

Right now, Stromberg-Carlson control systems are used with Detroit Edison's Enrico Fermi reactor... and will handle the Army's Joe Cap reactor—a portable, steam-driven unit that will feed power to a Deer Line station in Greenland.

Stromberg-Carlson systems provide instrumentation throughout a reactor's entire operating range, from the moment of start-up. An overlap of two decades in the source, intermediate and power ranges assures continuous monitoring. Light and compact, these systems can control marine, portable, research, or commercial reactors.



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VERTOL 76 tilt-wing VTOL aircraft, powered by single liquid-cooled T53 turbojet engine, was evaluated by NASA pilots during recent program of flight tests. Changes made in configuration by NASA included extra dorsal and ventral fin area and closed wing fairings. Wing position is shown set for short takeoff and landing performance. Wind tunnel tested in vertical tail and wing sections provide useful qualitative evaluation of surface patterns.

## Vertol 76 Enters Modification Program

By David A. Anderson

Meriden, Pa.—Vertol Model 76 tilt-wing VTOL, which completed flight evaluation last month, now enters a modification program reflecting state-of-the-art improvements in control and performance characteristics.

Planned changes are in registration on proposal stages between Vertol Division of Boeing Aerospace Co. and the U. S. Army, sponsor of the Model 76 project. Those changes suggested during the five-week flight testing of the research vehicle, aimed at proving the concepts of the tilt-wing design as the quickest and cheapest way possible.

Modifications are minor; they will be made in stages and may or may not stay on the aircraft. They are slated to include:

- Split ailerons divided in a spanwise sense, for interconvertible use control when the wing is tilted.
- Streamlined aileron control around the pitch axis.
- Full-span aileron to improve lateral control during airplane phase flight of the Model 76.
- Tipoverhang flap to increase both lift-drag wing area and available maximum lift coefficient.

### Variety of Changes

Already a different-looking configuration from what it was when its flying started, the Vertol 76 shows a variety of changes made by the company and by technicians of the National Aeronautics and Space Administration. Vertol installed a ground-level Martin-Baker ejection seat for the pilot after early flight-testing test made way, and changed the windshield—a Bell helicopter built-in to the front of the seat. NASA added extra dorsal and ventral fin area and closed the sides of the open rotor fairings.

Most recent at the NASA changes was a drop-inlet leading edge winged as thin as a coin and glass fiber cloth. That was intended to be a quick and dirty fix for loss of roll stability in a reduced power descent with the tilt-wing set at angles approaching 90 deg. As the descent velocity dropped, the wing angle of attack increased, and the

surface approached a stalled condition, making much more work for the pilot. Vertol was considering fixed cloth on the wing as a cure, but NASA found the simpler leading-edge modification adequate.

NASA's criticism work with the design, done on behalf of the Army which has no military pilots of its own, ended early last month. At that

### VTOL Future

Bigger ideas await for VTOL, air and in the immediate and longer-term field, says W. Z. Hightower, Vertol chief of research.

Speed stage at rock speeds, better than that of the helicopter but below that of long-range transport, makes it fit the short-term role. Takeoff and landing performance enables the VTOL craft to work out of helicopter-sized fields, and its main fuel-burner that of a light airplane and a helicopter of comparable power—adds to its attractiveness for operations in urban areas.

Vertol 76 represents our best concept which can be expanded into such an environment and, says Hightower, Hightower adds: Its place lies above helicopter and compound aircraft where range and speed are more important than low-wing efficiency.



VERTOL 76 in low-speed forward flight regime shows its only configuration before company and NASA changes.

time the Vertol 76 had a total of 50 hr flight time of which 20 were under the NASA program. The air frame, subjected to considerable stress and dynamic ground testing before it ever flew, now has a total between 600 and 800 hr time.

Experienced pilots with either fixed-wing or helicopter experience, or both have flown the tilt-wing design, and have made the conversion to type in a matter of minutes. One pilot started his conversion training with an "STOL" take-off—a short takeoff with the wing in tilted position. None of the pilots has reported any trouble in making the switch to the straight vehicle.

between between all thrust and all lift.

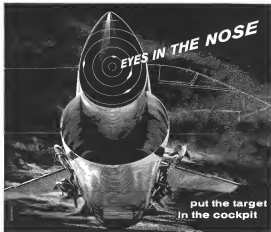
Power is supplied to a pair of fans at the tail, one mounted to control yaw motion and the other to control pitch. Conventional aerodynamic surfaces are

retained to handle control during flight of the Model 76 as an airplane. The fans control the pitch and the yaw of the vehicle during vertical or low-speed flight regimes. Roll control in low speed flight is done with differential



SHOOT TAKEOFF performance at Vertol 76 enables the tilted aircraft to get off the ground with a run of about two hundred feet. Variable wing position allows switching from vertical thrust to normal thrust via along a yaw control surface.

Vertol 76	
Weights and Dimensions	
Gross weight	5,350 lb.
Wing empty	2,500 lb.
Tilting span	34 ft. 11 in.
Wing length	25 ft. 5 in.
Height	18 ft. 6 in.
Rotor prop. diameter	9 ft. 6 in.
Tail fin diameter	2 ft. 6 in.
Wing area	130 sq. ft.
Wing model	NACA 4415 (modified)



As a result of development by the Magnavox Company in conjunction with the Navy Department, every Chance Vought F8U-2N Crusader Fighter Pilot sees the target at a glance—day or night, in any kind of weather.

Here are the eyes of a modern weapons system—a component that defines the rugged, weight and reliability so absolutely necessary to successful tactical operations.

This airborne radar system is just one of many systems which have been and are being designed and produced to satisfy the tactical requirements of the military services in the fields of Communications, Airborne Radar, ASW, Navigation, Fueling and Data Handling.

# Magnavox



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collective pitch on the rotorpage. Coderet linear machines a conventional helicopter position, with rotor disk mounted on the center, collective pitch lever at the pilot's left and rotor pedals. Wing tilt is controlled with a thumb switch on top of the rotor disk, like a standard twin rotor. Pushing the switch forward drops the nose of the wing toward the non-revolving position, and pulling back on the switch raises the wing toward the vertical. Full rotation from horizontal wing position to vertical takes a maximum of about 10 sec.

#### Control System

Control system operates through three phases in three different ways. • **Hovering phase**, with vertical motion controlled in collective pitch of the rotor rotorpage. In this mode, rotorpage, which uses the wing tilted vertically and therefore gives the rotorpage in a horizontal plane, will control comes from differential collective pitch repeated on the rotorpage by lateral motion of the rotor disk. Reversed skid motion, indicated by the lateral motion of the disk, indicates and the rotor disk control by differential skid motion velocity on the tilted wing. Pitch and yaw control comes from blade angle changes on the rotorpage, indicated by the forward and backward motion of the rotor disk to pitch and the rotor pedals to yaw.

• **Conversion phase**, which occurs between the hovering attitude and the time the aircraft is airborne on wing lift alone. The differential collective pitch sides not in line of action power, which moves itself from the hovering level and acts normally. Yaw and pitch controls remain in the line work, and division surfaces becoming increasingly effective in forward speed increases.

• **Assemble phase** when the aircraft is fully airborne. The collective pitch lever becomes a yaw lever, changing over in forward flight and control is taken on the rotor, and pitch and yaw come from both line and non-revolving surfaces.

#### Flying Rotorpage

After completing the pretest check, the pilot starts the engine and adjusts the engine speed. When the engine is up to speed and he has checked the instrumentation, he runs the wing up in the vertical position, repeats the collective pitch on both the rotorpage and the Model 75 rotor vertically.

He starts forward with the thumb switch, moving it forward to drop the nose of the wing. The rate of change is proportional to the deflection of the switch. As the nose drops and the aircraft begins to fly forward, the control leverages are automatically modified, so that differential collective pitch sides

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Standard and custom versions for shock and vibration testing. 10% accuracy over a 10 to 10,000 cps frequency range. Built-in battery for unattended tests and output in frequency, acceleration or g's.



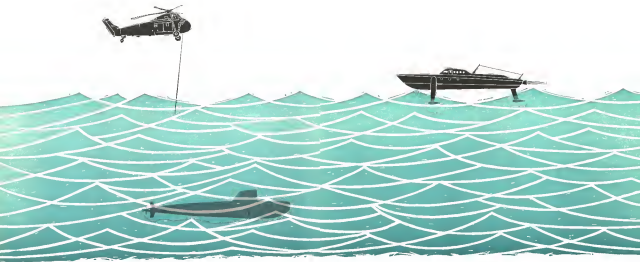
Standard design in 10 to 10,000 cps range. 10% accuracy over a 10 to 10,000 cps frequency range. Built-in battery for unattended tests and output in frequency, acceleration or g's.



Light and portable. 10% accuracy over a 10 to 10,000 cps frequency range. Built-in battery for unattended tests and output in frequency, acceleration or g's.



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## LORAL: Plotting both approaches to the anti-submarine problem

**AIRBORNE:** Our experience designing and producing anti-submarine warfare systems dates back to when submarines were chiefly a threat to fleets and shipping. With the advent of the missile submarine...with ranges and speeds greatly increased...we have applied our knowledge to developing much more sophisticated systems. We have extended the

state of the art with faster airborne computers, multi-target plotting equipments, aircraft position and heading displays, higher-accuracy and higher-speed visual display equipment, all with constantly increasing degrees of miniaturization and modularization.

Today, our ASW gear is flying on virtually every type of patrol aircraft. And tomorrow...

**SEABORNE:** Present research includes thorough investigation of the aspects of airborne ASW. "Seaborne" is a very large term, and we mean every area of it: underwater, surface ship, hydrofoil. Useful in submarines themselves are some of the mechanical equipments we have designed. For cruisers and destroyers, advanced computing and plotting systems are proposed. And for hydrofoils, which are analogous to low-flying aircraft, we are studying a complete adaptation of our operational airborne ASW weapons system. This will be comprised of naviga-

tional, target plotting and computing equipments capable of handling many tracks and targets simultaneously. Because of the high speed projected for the hydrofoil vehicle, the entire tactical system must have instantaneous response and great accuracy, the same as that for aircraft. —♦— These are a few research projects that will result in new systems here where the key letters in "hardware" are "R" and "D." If you are a senior scientist or engineer with interest in plotting other approaches to ASW, write LORAL Electronics Corporation, New York 22, N. Y.

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Regional Engineering Offices: Boston, Massachusetts; Dayton, Ohio; Torrance, California; Washington, D. C.

## OVER AND UNDER THE TOP OF THE WORLD

In early 1960, American craft pierced the North Pole in two elements. Fathers below solid ice, the USS *Serge* probed unerringly to "90 North"; miles above, a GAN-77 missile on a B-52 pinpointed the featureless goal. Both used Inertial Navigation systems by Autonetics—where today's results pave the way for tomorrow's breakthroughs.

Electromechanical Systems by **Autonetics**  Division of North American Aviation

out, and serious struggles. By the time the wing is full down, all will come from the aircraft.

The procedure is aimed for making the transition back from wing-down to conventional flight.

Since the initial transition flight in July, 1958, about 300 more conventional land tests made from hovering to forward flight and back again. More than 50 of these conversions were complete cycles. Out of 500 takeoffs and landings, about 200 were in the STOL category.

### Stability Augmentation

The Vertol 75 has been flown with and without stability augmentation systems, but they make hovering much easier for the pilot. In transition and forward flight with the wing at less than 45 deg angle, no stability augmentation is needed.

Basic idea of a four-wing test development program built around a simple and cheap flying tethered organism

in 1955 with W. Z. Streptowski, Vertol's chief of research. One of the first approaches was a design using a French Volkswagen Beetle used at 500 mph, in a vehicle weighing about 1,500 lb. Best availability of the latter Lycoming T53, divided to 500 mph for the job, dictated the final design of the Vertol 75.

Vertol got the contract on Apr. 15, 1958, sponsored by the Army and administered through the Office of Naval Research, an agency which has long spearheaded the drive for vertical flight. In 11½ months the Model 75 was rolled out of the hangar, and at this point, had a total program cost of \$340,000.

Paul Demet, who is project engineer for VTOL, said that he had between 30 and 40 men working on the design of the vehicle and on parallel investigation of rotor, motor, model tests and the like. To save money and time, Demet's team spearheaded available parts a Bell helicopter hubbale for the cockpit escape, wingtip sections from the



### PUMP PRIMERS

W. H. NICHOLS, JR.

Engineers concerned with device, motor, power, motor, gear boxes and turbine transmission design problems involving pressure fluctuations have found Gerdor type pumps extremely useful in their attempts to locate and solve down and under the water conditions with high speed reliability.

The Gerdor is a form of internal gear pump consisting of only two moving parts, an inner toothed element and an outer, rounded toothed element. The inner element has an inner tooth that fits into the outer and the "rotating" inner element is connected to a chamber to raise the fluid from the inlet port to the outlet. One Figure 11. Pump capacity is measured by the volume of the "rotating fluid" expelled by the action of the inner tooth and the outer.



Fig. 1  
Low relative speed and clearly held dimensions between the two Gerdor elements means high dimensional efficiency is maintained.

New spacing of the chamber as it increases the large inlet and discharge ports results in uniform flow and sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in fouling and lowered efficiency. Thus, Gerdor pumps offer considerable good performance at high altitudes.

Engineers find the Gerdor pump most efficient because there are several reasons: (1) the pump is simple and can be adjusted to meet the application requirements. Gerdor pumps are available in a wide range of sizes and capacities.

Fig. 2  
Modern of Zurich Steiner Pumps and the Pichon Wing Machine "The whole that sits in hand".

W. H. NICHOLS, JR.

Modern of Zurich Steiner Pumps and the Pichon Wing Machine "The whole that sits in hand".

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### Canopy Shelters F-105D Technicians

Crucial of emergency gear that shelters technicians at Republic Aircraft's Fawcettville, N. Y. plant in they test electronic systems of the F-105D fighter bomber.



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## **ND Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!**

Helping customers quickly instrument assembly is a specialty of the N/D engineering group. How? Through creative Miniature/Instrument ball bearing application and design. Often, a new ball bearing design will provide assembly savings in excess of 5% reduction in cost. Integral ball bearings, too, very often cut down difficult and costly hand assembly of shell and parts.

A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile general support. Here, special N/D Instrument ball bearings are now used in precision gunnery sights. New Department engineers recommended eliminating two single row instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They

replaced this assembly with a special N/D double row high precision instrument ball bearing with integral outer race guide roller... and shell mounted with a rail. This one recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the post-launcher selling price to the government. What's more, the New Department Instrument ball bearings improved post-launcher reliability!

You can look to maintain assembly costs and unsurpassed reliability. Include on N/D Miniature/Instrument Bearing Specification in your early design level documents. For immediate information or assistance, call or write Department L.S., New Department Division, General Motors Corporation, Pontiac, Connecticut.

**NEW DEPARTMENT**  
MINIATURE & INSTRUMENT BALL BEARINGS  
*Proven reliability you can build around*

NH446, as HRP had also for the Model 76 main landing gear, and nacelles was 31 21 parts contributed to the design. Reasons for the more popular Model because of their long and specific experience in that line, and Glenn 9 of the program. Everything else was done at Vertel.

Leonard LaVigne, Vertel's pilot for the Model 76 test, entered the flight phase of the program with a short hovering run Aug. 15, 1957. After a few modifications required by the behavior of the aircraft during test runs and the hovering phase of flight, LaVigne made the first flight in an airplane configuration Jan. 7, 1958, in which the Vertel 76 took off and landed on a runway in the conventional manner.

### **First Conversion**

First conversion from hovering to airplane flight took place on July 15, 1958, and to the vertical position, in which, this was the last point of the program. From there on, the jobs were those of refinement and final development, the concept had been proven. Company tests were finished Sept. 21, 1958, and the plane was sent to NASA for its evaluation which ended late in September of this year.

"We've spent a million and a half dollars to prove the concept," said Tharrell. "It took us about three years, which is about half a million dollars per year to keep the program going. I think it's a good return for the money."

Both Tharrell and Stephens point out that half a million dollars goes a long way on a project of this sort. The Vertel team had been able to design and build a test vehicle within a year and of less than a year and at a low project cost. Further, the overall program included parallel test and development work on the retro-propulsion and on the flight and control systems and also in the development of the engine and the engine. The overall program was a success.

### **Army's Move**

Both engineers point out that currently there is a bill in the program. "We're looking for some more changes," says Stephens. "Now we've got to wait for the Army to make the final step."

The next step probably will be a study of NASA's evaluation of the Vertel 76 and other projects, hopefully followed by further development efforts for operational vehicles designed to a certain experience. But such depends on the progress of budgeting for development work, and Vertel is not alone in wondering which way the trends will lead.

## **Propellant Briefs from Callery Chemical Company**

**Diborane: Fuel for Rockets, Ramjets, Turbojets**—Diborane (B<sub>2</sub>H<sub>6</sub>) is available in development quantities on a commercial basis and will be produced in large quantities at the basic building block for gasolene at the Callery-operated, government-owned Menzies, Oklahoma plant.

Development quantities of up to five pounds are shipped from Callery, Pa. Insulating techniques used for shipment and storage insure maximum stability.

*Write for technical bulletin C-202 and handling bulletin C-207.*

**Trisethylenborane: Effective Igniter and Fuel**—Trisethylenborane (C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>B is a fuel for ramjets and is used as an igniter for rocket and turbojet engines.

*Write for TEB technical bulletin C-310, and TEB handling bulletin C-311.*

**Nitrocellulose Perchlorate: (NO<sub>2</sub>ClO<sub>4</sub>)**, a solid oxidizer, is proving useful in various rocket system applications. Not shock sensitive when pure.

*Write for bulletin C-1255.*

**Pentaborane (B<sub>5</sub>H<sub>9</sub>): New Fuel for Air Force**—Potential of pentaborane as a fuel is illustrated by its high heat of combustion of 29,000 Btu/lb and its high specific impulse. T. O. Debbins in WADC TR 59-757 reports the following shifting equilibrium impurities for pentaborane:

Oxidizer	Imp 1000/14.7 P.sia.	Imp 1000/2 P.sia.
OF <sub>2</sub>	367	468
F <sub>2</sub>	360	460
O <sub>2</sub>	527	421
NO <sub>2</sub>	326	413
H <sub>2</sub> O	356	399
CO <sub>2</sub> F	366	391
N <sub>2</sub> O	304	390

*Write for bulletin—Pentaborane C-3100.*

For information or technical service: write Defense Products Dept., Callery Chemical Company, P.O. Box 11142, Pittsburgh 37, Pa. TWX Evans City, Pa. 336 • Phone Evans City 3510



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Crusader: A2F-1 Intruder, a carrier-based forward attack bomber capable of holding Mach 9 at sea level, is equipped with broad homopolar slotted steel speed brakes mounted behind jet exhausts. A2F-1 is powered by two Pratt & Whitney JT19B turbojets.

## Adjustable Tailpipes on A2F-1 Give STOL Effect



A2F-1 has been stalled, shown, at 125 kt; with power on, gear and flaps down aircraft has stalled at 80 kt. Adjustable tailpipes, actuated by Hyva, are mounted 7 deg. down from wing chord line and can be lowered 33 deg. more to provide STOL effect on takeoff.



Side-by-side two place Intruder shows carrier line fold-out auxiliary fuel tanks mounted on wing stations for long duration missions. A2F-1 carried three Mk. 44, 2,500 lb. GP bombs mounted outboard on each wing and under belly, and two Mark 46B Bombs.





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If you're considering the purchase of an ADF system, it will pay you to talk to your local Bendix dealer about the DPA-79. For further information, or for the name of your closest dealer, contact Bendix Radio Division, Avionics Group, Baltimore 4, Maryland.

## Bendix Radio Division

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BENDIX SALES & SERVICE: Dealer Inquiries: 202-343-4300 (Toll Free: 800-368-7661) Avionics Radio Division, 10000 Montgomery Lane, Suite 200, Bethesda, MD 20814. Bendix Radio Division, 10000 Montgomery Lane, Suite 200, Bethesda, MD 20814. General Tire and Rubber Company, 10000 Montgomery Lane, Suite 200, Bethesda, MD 20814.

## NASA Reports Confirm 75,000 ft. U-2 Altitude

Washington—National Aeronautics and Space Administration reports, now officially accepted that the Lockheed U-2 aircraft flew at a top altitude of 75,000 ft. rather than 55,000 ft. during weather flights over Europe, Turkey, Japan and the U.S. from 1956 to 1958.

These reports on three weather flights published by NASA and its predecessor, the National Aeronautics Committee for Aeronautics, in 1957 and 1958 indicated that atmospheric turbulence measurements were made in these areas at altitudes of 20,000 to 55,000 ft. Turbulent data D-545, just published by NASA, extends these reports and adds turbulence data gathered in the altitude range of 50,000 to 75,000 ft. on the same series of flights.

New NASA report also describes the system method of operating the U-2. Climbs to cruise altitude is made rapidly at rates varying from 5,000 fpm. to 2,800 fpm. Angle of attack is held constant during cruise, and altitude is revised as fuel is burned off. At the end of the flight, the descent is made at the rate of 2,800 fpm.

Average duration of the weather flights was reported by NASA to be 6 hr. for those made from El Est, Tex., about 2.5 hr. for the European operations and 4 hr. for the other flights.

Total of 115,000 mi. was covered by the U-2 on 192 weather flights reported by NASA in TN D-545. Included in the total are 31 flights covering 111,174 mi. made over the southern U.S. from November, 1956 to December, 1958 and not reported previously. Number of flights listed in the new report as being made over Europe, Turkey and Japan in the same total given previously. The total number of flights under has been adjusted, however, and it is now 65,219 at highest. Presumably these under were logged at altitudes between 60,000 and 75,000 ft.

Results of turbulence studies by the U-2 have provided valuable design data for the design of B70 and super-sound transport.

They show:

- Turbulence from 60,000 to 75,000 ft. is both less frequent and less severe than turbulence between the altitudes of 20,000 and 40,000 ft.
- Aircraft flying between 60,000 and 75,000 ft. are in turbulence no less than 2% of the time. For given volume of gust activity, the frequency of gusts at these altitudes is less than one-fourth that at the lower velocities.
- One notable exception has been found in these findings. Over Japan the air from 40,000 to 60,000 ft. appears more turbulent than at lower altitudes.



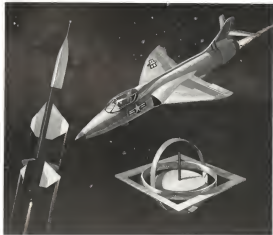
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## 20-pound inertial platform

By a precise balancing exercise, this silent, shapeless "pilot" will keep its craft on course as it streaks through space. The miniature, all-attitude inertial platform detects any pitch, roll or yaw deviations and is the heart of a precise navigation system.

The best news of all concerning this new inertial platform is Norden's success in achieving higher accuracy and reliability . . . in a significantly smaller package. The unit measures a mere 12 x 9½ inches and weighs less than 20 pounds. It offers engineers

state of the art wherever stabilized spatial reference is required. This engineering accomplishment once again underscores Norden's capability in the fields of digital computing, gyro design and applications, reliability techniques, and precision manufacturing. And it is a demonstration of the Norden philosophy at work . . . to extend man's capabilities.

Stimulating questions are available at all levels of responsibility for qualified engineers and scientists.



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WING TUNNEL MODEL 3070 is currently being modified in the configuration of the display model at right. Chance Vought's V/STOL logic transport, capable of carrying 20 soldiers, would have articulated wing tips to droop aftward downward for vertical or short takeoff and landing. Wing (tunnel) model has forward fuselage and legs.



## Chance Vought Studies V/STOL Design

By Ervin J. Balbon

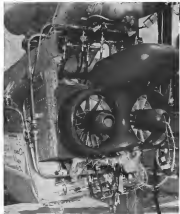
DALLAS, Tex.—Chance Vought Aircraft, Inc., could fly the prototype of a vertical or short takeoff and landing logic transport capable of flying 400 kt. and having a ferry stage of more than 1,000 mi. in two years from design go-ahead using currently available hardware and state-of-the-art knowledge, the company reports.

Chance Vought engineers have been studying V/STOL transport problems here for the past two years, using company funds, and have developed a propulsion and control system utilizing four Pratt & Whitney J60 turbines driving ducted fans.

### Design Concept

Their concept is termed ADAM, for air deflections and modulation. As designed and tested here—both in outdoor wind tunnels and in the company's low-speed wind tunnel—the fuselage, wing, power generation and transmission and control system are integrated in a single package to generate both lift and forward propulsion. The four fans are arranged side by side in pairs on either side of the fuselage, their axis are parallel to the line of flight.

The propulsion system is a non-overlapping turbine design, two J60s mounted above paired fans. The fan drive turbine for each engine is not integral with the engine but is smoothly mated. Compressed gas from each engine flows aft through an intercom-pressed fan gas duct and drives a turbine at its aft end. A constant connection between the pairs of ducts on both sides of the airplane can be used to couple engine thrust to the four fans.



TESTBED BIG of Chance Vought's ADAM V/STOL propulsion and lift system has been built outdoors for large-scale tests of the system, including duct entry chugs. The scale model represents one complete power system. The large gas expander two Pratt & Whitney J60 turbojets which would drive the two turbines.

The diagram illustrates the four steps of the Wave Soldering process:

- CABLE TO BOARD**: A cable is being soldered to a board.
- BOARD TO CABLE**: A board is being soldered to a cable.
- BOARD TO BOARD**: Two boards are being soldered together.
- BOARD TO BOARD**: Two boards are being soldered together.



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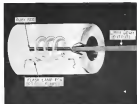
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## AVIONICS



**PULSED ruby optical maser** which produces high-intensity beam of coherent light, has application for space vehicle communications and may also open up a new era of time for data transmission. Device at left was developed by Bell Telephone Laboratories. Draw at right shows that optical maser is extremely simple, consisting of a thin rod of synthetic sapphire, situated at each end, which is excited by pulses of light produced by helical flash tube. Output beam is 3.1 deg. wide, more intense than sun.



## Optical Maser's Space Potential Probed

By Philip J. Klein

New York—Bell Telephone Laboratories experiments have revealed that an optical maser radiates infrared-visible light effects, such as coherent light being emitted, as short laser-emitted beams, rather than as a smooth pulse as had been previously reported by Hughes Aircraft company (AW July 16, p. 78).

This suggests that it may be possible to modulate the emitted light for space communications and conventional radio-based communications. BTL scientists speculate that no lines of non-communication channels may be opened by the use of modulated optical

maser light beams transmitted through dust-free vacuum.

Using the newly developed optical maser as a source of high-intensity, narrow-beam light, BTL scientists have transmitted pulses of light between Mount Hill and Holmdel, N. J., a distance of nearly 25 mi. Optical maser light pulses also have been transmitted along a quartz rod of two-inch diameter circular cross-section, pulled to permit light beam transmission from dust and fog (AW Oct. 30, p. 34).

### Synthetic Ruby

The BTL optical maser uses a synthetic ruby crystal, explored in a manner originated by T. H. Maiman of Hughes, who first observed the optical maser effect in ruby. The BTL crystal is about 14 in. long and 3.2 in. in diameter.

When excited by a klystron, fed by a bank of condensers, the ruby rod emits narrow pulses of light, in a wavelength of 6943 angstroms and of a bandwidth of less than one angstrom. This naturally monochromatic light, emitted within a cone angle of about 3.1 deg., is more than a million times brighter than the sun. BTL says.

The results of BTL's optical maser experiments check with those of Hughes, except that Bell scientists found that pulses of light emitted contained several hundred narrow sharp bands, each of about one megahertz duration, superimposed upon the average modulated light intensity. If these were observed by Hughes scientists, they

were not reported at the time of their announcement several months ago.

The ruby employed in the optical maser is synthetic aluminum oxide, in which a small fraction of the aluminum atoms are replaced by chromium atoms. Normally the chromium atoms, which produce the optical maser effect, are at their lowest energy level, one which is stable unless the atoms are excited.

If, however, the ruby's chromium atoms are exposed to green light of the proper wavelength, as a light flash which contains green along with other colors, the chromium atoms are excited, absorbing energy from the green light, and they will be raised to a high-energy level.

This high energy level is an unstable one, and the atoms quickly fall back to an intermediate energy level, causing energy in the form of red light in the



**WHEN OPTICAL MASER'S** ruby rod is illuminated by green or white light containing any green, chromium atoms in the ruby absorb energy, rise to highest energy level. When they rapidly drop to intermediate (unstable) level, which they slowly return to lowest level giving off red light, called spontaneous emission.



**SILVER COATINGS** at each end of ruby rod means spontaneous emission light to be reflected back and forth, which causes atoms of unstable level to cascade down to lowest level, producing intense red light which passes through thin coatings at each end of the rod, giving coherent beam.

**Will The Mission  
Succeed?**

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# DATS

(Dynamic Accuracy Test System)



Flight-line checkout by DATS (Dynamic Accuracy Test System) tells the interceptor commander whether his aircraft and weapon control systems are completely ready for a successful mission. As a result of field evaluation tests, showing the effectiveness of DATS in improving weapon control performance, RCA has been awarded an Air Force production contract. Developed by RCA's Airborne Systems Division, Defense Electronic Products, Camden, New Jersey, DATS is a new approach to the evaluation of system readiness.

It makes certain that only aircraft with properly operating weapon control systems are sent on missions. Based on a building-block design employing the highest reliability factors, a mechanical programming device and self-test capability, DATS simulates a series of synthesized attack runs typical of mission conditions. DATS could be made applicable to many interceptor types of aircraft.



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process. This level is termed the "aseitable level," being more stable than the high level, but less stable than the original low level.

Steady state of the chromium atom is the available energy level value, giving up energy in the form of red light, and return to their original low energy level. This is referred to as "spontaneous emission," corresponding to the atomic fluorescence of rub. This is similar in principle to the light given off by a conventional fluorescent lamp when excited by electrical radiation generated within the lamp.

If, however, the chromium atoms at the available energy level are exposed to red light of precisely the same wavelength as they emit when dropping down to the lowest energy level, they will be stimulated to make the "last jump" more quickly.

#### Stimulated Emission

To produce the stimulated emission, both ends of the tube rod are optically ground parallel and silver coated to provide reflecting surfaces. As the few chromium atoms at the available energy level begin to drop back to the lowest level due to natural causes, the red light they emit in the process ("spontaneous emission") is effectively trapped within the tube rod, being reflected back and forth by the two mirrored ends.

This spontaneous emission light is precisely the correct wavelength to activate the bulk of the chromium atoms in the available level, causing them to fall back to the lowest energy level and emit intense red light as the process.

#### Duration of Process

The process continues as long as there is a supply of chromium atoms at the available energy level. This will exist as long as the green or white light is pumping atoms from the lowest level up to the highest level from which they can drop back to the available level.

The mirrored surfaces at each end of the tube rod are coated sufficiently thin to permit a portion of the intense red light to pass through. It is this externally emitted beam of light that was used as RFL's long-distance experiments.

One of the most interesting properties of the optical maser is its ability to generate coherent light, the first known source of such light. Light produced by the sun, incandescent or fluorescent lamps is incoherent, with the particles of light emitted in completely random fashion.

The light emitted by the optical maser consists of packets of light which are coherent waves, exactly like radio or sound waves. This coherence has been

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### Missile Monitor

Missile monitor development advances, Type TS-8A, is intended to suggest how to permit close exposure to rocket engine heat. The transistorized camera provides 64-line resolution, can be equipped with low-loss lens. Device mounted 111 in long, 51 in in diameter. Manufacturer: General Electric Communications Products Department, Lynchburg, Va.

documented by scanning two fine, parallel slits in a thick glass coating on one end of the tube end. The pattern of emerging light showed that light from the slit was scattering with that from the other, an indication that the emitted light was in phase across the end of the rail, BTL reports.

The underlying reason why the optical system generates coherent light is not fully understood. It may result from the cooperative position between the spontaneous emission light, reflected back and forth, and the stimulated wave emission, perhaps reinforcing the motion of a field and electron beam in a laser.

The light emitted by the tube under stimulated emission (laser action) is much more nearly monochromatic, by a factor of 60:1, than light produced by spontaneous emission as atoms fall back to the lowest level because of natural causes.

### Piled Output

BTL scientists have developed a theory which explains the pulsating output of the ruby-mirror-coated light. Each of these pulsations, or bursts, is less than a microsecond long and occurs a few microseconds apart.

This theory holds that when the pumping feedback is dissipated results, it builds up a supply of atoms at the metastable energy level. As spontaneous emission occurs, the intensity of light in the ruby builds up to a point where it stimulates the intensity of the dissipation above the metastable level to cascade down to the lowest level, producing an intense pulse of light. This dissipates the metastable atoms so rapidly that it then requires a short interval for the feedback to pump enough dissipation atoms to replace the depleted population, causing

a drop in the emitted light intensity. When the supply of dissipation atoms in the metastable energy level builds up, the cycle repeats itself.

Bell scientists report that these pulses, or spikes, become more pronounced as the thickness of the silver coating at each end of the tube and a metastable and the more nearly perfect the rod's geometry. The interval between spikes has been found to decrease as the exciting krypton intensity is increased. Similar phenomena have been observed in ruby lasers at microwave frequencies.

In subsequent experiments, in which ruby crystal was immersed in liquid nitrogen for cooling, Bell scientists found that the threshold for the occurrence of dissipated emission was 30% lower than at room temperature.

### Further Research

BTL sees its optical laser effect as expanding into techniques for modulation, amplification and detection, as well as research on the laser-emitter properties of atoms other than ruby suitable for operation at other optical frequencies.

Bell Telephone Laboratory scientists engaged in the piled ruby laser experiments include: R. J. Collins, D. F. Nelson, A. L. Schawlow, W. L. Bond, C. G. B. Garrett and W. K. Kaiser.



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### PYROTECTOR

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## Cooper Development Division to Centralize Operations in Van Nuys

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tude or space probe systems are designed for wind measurement; meteorological, radiation and biological information; and similar military and scientific high altitude aero/space programs.

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## Tom Swift and his moon rocket

*All was ready. Tom called to Professor Damon, "Let's start our high energy, liquid hydrogen rocket engines!"*

*The professor wiped his glasses and agreed, "Bless my overshoes, let's!"*

Fiction? Only the names have been changed. The rocket is really a development of the National Aeronautics and Space Administration, and its name is Saturn. Its first stage will develop a thrust of 1.5 million pounds—twice that of anything the Soviets have fired so far. It is designed to take two men around the moon and back.

You can read the full story in McGraw-Hill's AVIATION WEEK and Space Technology, as covered by Space Technology Editor, Everett Clark.

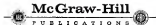
Clark has kept AVIATION WEEK subscribers abreast of space developments (U.S. and Soviet) long before Sputnik I put the international spotlight on space technology. He personally covered launchings of the *Atlas*, *Titan*, *Thor*, *Jupiter*, *Redstone*

and *Polaris* missiles—and also Explorer satellites, Pioneer lunar probes, Pioneer V Venus probe and *Juno* satellites.

From this extensive background, Clark directed preparation of AVIATION WEEK's first special issue on space research in 1955. He has also been responsible for other special issues on the NASA and the Air Force Air Research & Development Command and has written extensively on Soviet space developments.

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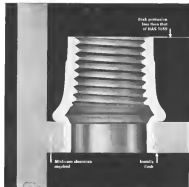
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Everett Clark (left) checks technical details for a story of the Saturn with E. R. Tamm, deputy director of the Test Division, Marshall Space Flight Center. A space technology specialist since 1935 in Germany and the U.S.A., Tamm typifies the authorities that McGraw-Hill editors like Clark work with in covering a story. Clark himself has covered international space meetings in London and Stockholm . . . maintains contact with men like Tamm on space research around the world.





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Only one hole in the sheet is required for Davis Press Nut. Hammer should be sufficient to accept the nut up to the knurling.



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in a new history which uses multiple electron beams within a single structure, capable of producing more than 100 times more power than conventional klystrons, the company says. Other tubes, called the Cathatrons, can convert field pulses to develop audible power levels in the micro-millisecond band. GE has set up a new Supercomputer Microwave Tube Laboratory to translate new technologies into operational hardware.

►Nile Zee Computer Installed—First prototype of target intercept computer to be used for guidance of Nile Zee anti-SCM missile, has been installed at the White Sands Missile Range, N. M. Computer, built by Raytheon Read-Down for Bell Telephone Laboratories and Western Electric, is called the first and most reliable ground guidance computer to be developed. Computer contains 175,000 basic components: employing modular construction for quick replacement of a faulty unit. Computer uses "twisted" memory elements, developed by Bell Telephone Laboratories.

►Solar Cell Costs May Be Cut—Technology developed by Avco scientists for making radiation-resistant silicon solar cells, using phosphorus doping of P-type silicon, may cut cost of making solar cells by increasing yield. New process



### Samos I Orbiting Vehicle Payload Capsule

Capsule contains payload of solid Samos orbiting vehicle. It was generally described as "best photographic and related equipment." (AW Oct. 17, p. 31)

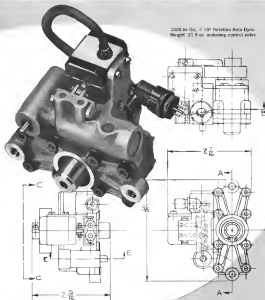
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2,000 in-lb.,  $\pm 20^\circ$  Rotation Rota-Dyne. Inlet valves are on test with closed control valve.



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### Rotary Proportional Hot Gas Servos and Pneumatic Actuators

The Rota-Dyne is a trac rotary servo which can maintain angular load position over ranges less than a full revolution. It employs a unique scaling technique which is quite simple, but virtually leak-proof and highly reliable. Developed in a company-sponsored program, Rota-Dyne offers these advantages and design features:

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- Close coupling, little structural feedback

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- Low weight to torque ratio
- Mechanical position feedback
- Frequency response within 3 db to 15 cps
- Inlet gas temperatures to 2000°F
- Tapco supplied liquid or solid gas generators
- Low production costs

If you would like further information on Rota-Dyne servos, write on your company letterhead. Tapco Group sales engineers are available for consultation in your convenience.



10,000 in-lb.,  $\pm 5^\circ$  Rotation Rota-Dyne



## TAPCO GROUP

*Thompson Ramo Wooldridge Inc.*

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All connectors may look alike but when faced with the test of performance... contact crimp reliability makes them all different. The big difference between other connectors and the AMP crimp connector is the snap-in design control effected to the wire by AMP's precision-controlled, compression crimp technique. Twenty years of identified research, development and production stand behind the industry accepted compression technique which produced Solistrand, Diamond Grip, Pre-insulated Diamond Grip, Plastic Grip, Certi-Crimp and the

more than 15,000 different AMP circuit termination products. This is the common denominator which explains our unquestioned reliability in all our products including the AMP crimp connector line. **ANOTHER AMP FIRST!** Now AMP offers repeated, automated application of AMP crimp contacts. Production levels of up to 1,800 terminations per hour can be achieved with standard A-MP-O-ELECTRIC machines. Also, the AMPORAMATIC crimping tool is available for repeated terminations in hard-to-reach locations.

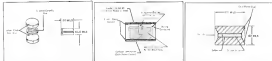
Visit us at the A.E.S. Show, Los Angeles, Oct. 26, 27 and 28 1960, Booths 313 to 315.

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**UNIQUELY** packaged, leadless wire components (AWG Sept. 5, p. 50) are inserted into plated-through holes of insulative board (440 is first step of constructing P. R. Mallory's Uniform Component Assembly). Partially completed assembly, with solderless conductive connecting components clearly visible, is dipped into container of protective coating (right). Mollery will provide complete circuitry map for cylindrical wire components and assembled in this fashion. Alternatively, it will sell leadless components separately for use in heron's own packaging scheme.



**THREE** jetted-dipped components made by Mollery are a remote separator (left), leadless capacitor (middle) and silicon rectifier (right). Uniform component configurations are expected to simplify manufacture and testing, ease shipping and storage and permit high component density packaging in complex electronic equipment.

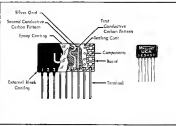
## Uniform Component Packaging Offered

By Barry Miller

Los Angeles—Flexible, uniform-packaged, micro-miniature components potentially capable of simplifying and cutting the cost of assembling components into complex systems are being developed here in a series of trials before major systems orders in the greater Los Angeles area.

Engineers from P. R. Mallory & Co., Inc., described the Indianapolis component manufacturer's family of leadless, wirelessly-shaped components (AWG Sept. 5, p. 50), encompassing some 100 of which are now available. The components—capacitors, resistors and a switch—are each housed in cylindrical-shaped, cylindrical, or pill-box shaped packages. To round out the line, Mallory intends to prepare inductors and to package semiconductor diodes and transistors in the same format as lead semiconductor semiconductor wiring to package these components in the desired micro format.

Advantages of this uniform component concept for both component



**CIRCUIT** package containing cylindrical-shaped components is constructed by inserting components in insulative board, selective coating with acid, epoxy covering with thin non-conductive layer—the first of which is sealed—and then coating within two external protective layers.

count them...

...9 basic types

count them...

...9 basic types

count them...

...9 basic types

count them...

...9 basic types

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...9 basic types

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...9 basic types

count them...

...9 basic types

count them...

...9 basic types

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...9 basic types

count them...

...9 basic types

count them...

...9 basic types



manufacturers and system providers are the following:

• **Product uniformity.** Higher production rates and consequently lower costs passed on to the equipment owner result from standardized equipment.

- Reduction in amount and complexity of equipment and problems confronting extensive assembly of components and joints

### Marketing Plans

JOURNAL WIRE, October 24, 1962



For this vital project, distinct and accurate telemetry signals on each channel are an absolute must. Only the highest quality workmanship and electrical performance is acceptable to engineering inspectors for McDonnell Aircraft, prime contractor.

The same high standards of quality and performance extend to the many other telemetering systems and components being supplied by Dersutt for today's advanced aerospace programs. For more information, write today!



502



## CENTRAL AIR DATA SYSTEM

HOW GIANNINI  
HELPED  
SOLVE  
A SYSTEM PROBLEM  
FOR THE GRUMMAN  
W2F AND A2F!

Before your aircraft project is ready for prototype testing, its CADS (Central Air Data System) must learn to do more tricks between input and output than a three-armed juggler, and with no chance of fumbling the crockery. No wonder project decisions are often hampered by confusion of reported revision of requirements and cost of replacing the crockery after delivery. But Giannini worked closely with Grumman to solve those problems with Central Air Data Systems for the Navy's new aircraft, the W2F and A2F. Here's how - Given input  $P_0$ ,  $P_1$ ,  $T_1$ . Required analog and digital output proper-

THE  
**INPUT**  
THE  
**OUTPUT**  
AND THE THREE-ARMED  
**CADS**

tural to Mach, impact pressure, altitude, true airspeed. The method: Use of Giannini pressure transducers as heart of system; flexibility of design to allow changes without drastic revision; modular construction to permit quick, nonpenetrant replacement and repair; reliability based on Giannini's unequalled depth of experience in air data instruments, aerial instruments, servo components and related systems. Result: Extremely small, lightweight components with amazing accuracy and service life. Giannini's systems capability can help define and solve your control problems, too. We're as close as your phone.



CARQON composite pilot center of type employed in Mallory program has also coated end plates for transducers.

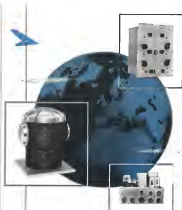
including arrangement, referred to as Universal Component Assembly.

Isolates critical air standards packaged micro components in electric form of the same or compatible size which would considerably simplify assembly of system and provide the high component densities required in space stations was expressed verbally and in recommendations adopted at a meeting of the Subcommittee on Microelectronics Components of the Electronics Industries Association (AEE Sept. 5, p. 98). Representatives of various manufacturers at that meeting indicated that they would produce components with leads no larger than 90 mils in diameter and 60 mils in height, and active components no longer than 165 mils in diameter and no higher than 60 mils. While no recommendations were proposed for leadless components, neither formers nor defines. Sample Mallory components are presently 160 mils in diameter and 60 mils in height. Mallory will attempt to settle on dimensions satisfactory to the subcommittee and other industrial needs, according to Stanley M. Strickland, a Mallory staff engineer on the microelectronics program.

Use of such dimensions, however, components poses an unusual problem in package design. Where component pattern must be known, it can be indicated, however, by the use of a magnetic material on one end of the pellet, as Highgate Semiconductor Products is doing with its components).



OUTWAYS infinite possible configurations of three expected to be added to Mallory's unitarily packaged aircraft components.



**+1 1/2**  
**-1 1/2**

## VERTICALITY

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The Army Signal Research and Development Laboratory assigned us the task of designing and building these vital links with the Gemini satellites.

Each antenna consists of a multi-frequency feed, 20 ft parabolic, tower and instrumentation. The system is a constantly scanning automatic target acquisition and tracking system and for two-way communication with the Gemini satellite.

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antenna in azimuth, remote and automatic tracking modes, and for pointing at a prescribed rate and direction if the signal is temporarily lost. High gain requirements (19 db at 135 mc and 43.5 at 2300 mc) and critical gain-pointing (±1) for accurate tracking accuracy. This is achieved to within 1/2 degree at a tracking rate of 15°/sec.

Antenna systems like this are but one of Radiation's many capabilities in the field of advanced electronics. A number of others is found in our latest "Capabilities Report." Write for it.

Radiation Incorporated, Dept. AF-60, Melrose, Texas.



**RADIATION  
INCORPORATED**

space studies. Similarly, pellets might be chosen with a needle with Malloy microprojectiles at one end of the actuator, or some other visually distinctive means.

Malloy, one of the oldest and most respected names in the component business, is rather cautious in its approach to microminiaturization. In response to a question asked at a meeting with Avianics engineers, the company explained that its program is still in the planning stages, that the focus of its meetings here on the West Coast are to sound out engineers' reactions to its package, mainly concerned that their components meet such large, conventional components in reliability and stability before they'll be accepted on a large scale. Consequently, extensive reliability tests, the Malloy engineers note, are not in progress at the company's research laboratories, but the results of these tests are not yet available. Reactions of engineers at one meeting attended by Avianics' Witek appeared favorable and comments indicated an special questionnaire distributed by Malloy at the meetings were very encouraging. Stabilizing soil.

Among the companies in the Malloy system component line are:

- **Carbon composition resistor**—Peller carbon composition resistors are made from carbon-conductive material mixed with a fusible ceramic filler varying the resistivity of the material and a phenolic resin binder. Conductive silver terminations at either end of the pellet are bonded to the carbon element. Several thousand carbon composition pellets fabricated to date meet MIL-R-11C, except for a voltage coefficient slightly in excess of 0.05%/volt. Characteristics of tested resistors of this type are: 0.1 watt at 700°C power rating, tested to also at 125°C; 10 ohms to 22 megohms resistance ranges with ±5 and 10% tolerances, 125 v. d.c. at max. maximum continuous voltage rating, storage temperature of +55 to +55°C, -55 to +252°C operating temperature, ±5% to 25% resistance temperature characteristic. One hundred mil diameter by 62-mil-high pellets, ranging in value from 5 ohms to 5 megohms with 1/2 watt power dissipation are available at 550 (net up charge per order) plus 51 per cent profit with 30 to 45 day delivery.

- **Metal oxide film resistor**—Resistors of this type are available where high stability and low tolerances are necessary and high frequencies are encountered. Pellet types of which a number have been made consist of a thin ceramic tube over which a metal oxide film is deposited and then etched away in a special fashion. Film resistors yielded by this process are used at 1/2 watt and meet MIL-R-11806A. Like the carbon composition, pellets, the metal oxide film resistors will be made in 193 mil diameter, mil-high packages and are available in resistance values to 25,000 ohms with power and delivery quoted on request. Eventually, film pellets in values up to 75,000 ohms with 5 and 10% tolerances are expected from 20 to 200 ohms per square film now used. Higher resistivity films, for higher resistance film pellets may emerge from present work.

- **Ceramic capacitor**—Several thousand ceramic disk capacitors made of materials like boron nitride have been fabricated. The disk is pressure-cooked and fired in an oxidizing atmosphere at 1,200°C to 1,400°C until variations taken place, Malloy said. Silver paste coating applied at both flat surfaces of the disk are fired at 700 to 800°C and thin (several) metal coils are bonded to the silver in a hot oil bath. A 108 mil-dia pellet using a 20-mil-thick ceramic disk, provides a 400 picofarad capacitor. Pellet ceramic capacitors are purchased in values up to 400 picofarads, 400 mils, in 100 mil diameter, 62-mil-high packages up to 1,000 picofarads, 75 mils, in 100-mil-diameter by 50-mil-high packages, and up to 5,000 picofarads 400 mils by 250-mil-diameter, 62-mil-high packages. The price is \$50, plus 50 per cent profit with 30 to 45 day delivery.

- **Tantalum capacitor**—Tantalum capacitors, in two cylindrical sizes and two microfilm-size products (where selection of one factor, capacity or potential, fixes the second factor) with capacitance tolerance of ±20%, are available. The two pellets measure 16 mils in diameter, 62 mils in height and a larger one 150 mil diameter, 70 mil height. Microfilm-size products for the former are 30 (caps) ranging from about 2 to 25 pF and 27 for the latter. An accompanying drawing shows typical micro film electrolytic tantalum capacitors with pins, and another fully tantalum oxide and manganese dioxide solid electrolytic. Visual or magnetic marking of polarity is attained by coating the oxide with no-plated nickel or steel and the cathode with gold plated copper. Values of 100 pF and 100 nF will be supplied on request. Tantalum solder, 100 mils square with 150 microfilm-size products and production quantities of tantalum slugs, 70 mil diameter, 21 mil high, 62 mils, with 40 capacitance values can also be purchased from Malloy.

- **Silicon resistors**—In the common for use, 180 mil-diameter pellets, 62 mils high, are made consisting of a silicon wafer with gold-plated film soldered to the wafer and cathode, are available. Here again, different colored disks in varied magnetic properties of the disk provide polarity determination. The resistors have peak average

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for the Sperry  
Turbine Vibration Indicator*



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IN  
PRODUCTION

## Sperry TURBINE VIBRATION ANALYZER indicates source of vibration in Turbojet and Turboprop Engines

- PORTABLE • TRANSDUCERLESS
- REPENDABLE • SIMPLE TO OPERATE

Now in full production, the Sperry TVA—Turbine Vibration Analyzer—is ready to go to work on the flight line or on the test stand. An electronic trouble-shooter for turbojet and turboprop powerplants, the TVA can save hundreds of thousands of dollars for the airlines by locating and diagnosing engine trouble before it starts damage to them—thus reducing maintenance costs and unnecessary engine overhauls.

Weighing only 35 pounds, the TVA

specializes itself by "selective tuning" to each of the engine's major rotating components, and automatically tracks the component's vibration through the range of engine speeds. Any excessive vibration shows up at once, and the component or accessory which is at fault is localized and identified. The mechanic then makes necessary repairs—in a fraction of the time and at a fraction of the cost of trouble-shooting methods of the past.

As a complement to the Sperry Turbine Vibration Indicator, which monitors overall engine vibration in flight,

the Analyzer pinpoints the source of excessive engine vibration. The TVA-TVA tests means greater overall engine reliability and maintenance economy. It is the only portable and transducerless unit of its kind—and is engineered and built to treatment Sperry standards of quality and dependability. Send for technical data.



AERONAUTICAL EQUIPMENT DIVISION, SPERRY GYROSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION, BOSTON 16, MASS.

voltage ratings of 400 volts, will give 300 milliamperes in the forward direction at 25C, with linear density to zero only current at 174C. Homopolarly-joined sections with peak reverse voltage ratings up to 1,000 volts and forward currents at 200 milliamperes at 25C may be feasible, according to the company.

Other potential components such as lenses of about 50 milliamperes and speed cone induction of about 50 mweas become appear feasible. Unusual microstructure techniques electrolytic capacitors, as 15 to 150 milliamperes developed for the Navy Monomethyl program are the available and useful scale time for order mounting will be made soon.

For those companies which do not wish to build their own semiconductor Muller has devised his own technique, similar to one employed as an experimental basis by Hughes Semiconductor Products, for packaging semiconductors into metal enclosures. In this packaging scheme, pellet components and terminal caps are inserted into plated through holes and then a 0.1-in. or so is soldered in. The perforations are mounted on a 150-mil grid system. A small base point soldering unit is then spread on the board through a mask which leaves the centers of each component mounted so that interconnection contact can subsequently be made. These conducting coatings are applied next.

First conductive surface is spread on through a mask of the interconnection wiring pattern, so that the solder which follows can make contact with the component centers. A third and final layer, carbon paste, is applied. This sandwiching of the silver between the carbon layers creates a low voltage gradient and blocks migration of the silver.

An epoxy resin coating which provides mechanical strength and resistance to moisture is then deposited on the structure. For additional protection against moisture and to provide a smooth external coating for identifying markings, the assembly is dip-coated with black varnish base paint.

Several circuit types fabricated and demonstrated at the presentation. A 44 resistor in one was claimed for a multi-factor hybrid package consisting of commercially available conventional components and diodes and pellet capacitors. When pelletized components and diodes are made available, a 10:1 size reduction can be expected, according to Muller.

Advantages claimed by Muller for his packaging approach are:

- Reliability—Components are regularly inspected within the time period, protected by external coating, ultrasonic tested directly without leads. The first package from good thermal design-

## PROBLEMATICAL RECREATIONS 37



A and B live at two opposite corners of a square for C and D live at the other two corners. They all carry water from a spring located within the lot, which is 5 rods from A, 4 rods from B, and 3 rods from C. How far must D carry water?

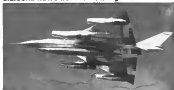
—Colinvaughn, England

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ANSWER TO LAST WEEK'S PROBLEM: If the height is 4, after the first drop it rises 10 ft, next 14 ft, etc. The distance up and down then is twice  $(10 + 14 + \dots)$ . The first drop is 4 ft, so the total is 36 or 38 feet.

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Dope! 1950s for  
information



**Dow Corning CORPORATION**  
MIDLAND, MICHIGAN

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New — fastest, most reliable, easily installed method of sealing holes that leaks at low or pressure points. The Lee "Pin-Plug" is a cylindrical plug with a tapered recessed hole parting through its center and numerous small grooves on its outside surface. Simply place it into reamed hole and drive in the tapered pin until ends are flush. Controlled expansion causes grooves to plug to "form" into coating and forms independent seals and retaining rings. Extensive laboratory tests report no leaks under normal pressures, often show leak-free seals up to pressures of 40,000 psi.

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\* See #487155



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tion. No dip soldering of components is employed.

- **Design flexibility**—Standardized gasket sizes, layout of holes and tapered openings allow wide choice in circuit layout.
- **Production flexibility**—Standard sizes and shapes favor automatic assembly and simplify storage of parts. Change-over in design or special design can be achieved with a minimum of lead time and tooling expense.

- **Miniaturization**—Many components can be housed in a single assembly—square, oval, shell, board. Projected component densities of several hundred thousand parts per cubic foot are anticipated.

- **Thermally-stable construction**.
- **High shock and low noise.**

Miller's packaging approach is similar to one developed by Hughes for which Miller has made positive components. In the Hughes scheme cylindrical components with 50 mils in diameter and 18 mils in height are inserted into drilled holes along a 100-mil grid and solder in a Weld Thick Coating Potassium bond. Hughes claims it is even experimental results (NAV Sept. 5, p. 107) in this arrangement.

Interconnections are made along horizontal insert strips on one side, vertical strips on the other. Connections between the two strips are made by plating through holes, thus avoiding cross-over problems.

These little assemblies can be soldered into a printed circuit board. Automatic packaging schemes considered by Miller, envisage plug-in assemblies, horizontally stacked modular boards, with built-in test points for built-in test connections.

In an effort to acquire design experience with its main component approach and its Universal Component Assembly, Miller plans to sell low-cost electronic kits. These would consist of an assortment of components, base boards, plastic materials and means for component interconnections and test connections. In this way, the company can actually sample the Miller approach, see how it suits him and criticize his needs.

Refine plans into full production of its main component line, Miller wants to see how well the components and packaging concepts are received by system design engineers. The trip here was an early step, to be followed by a tour and series of presentations at major computer and the East Coast during November. The itinerary for the next trip is not yet complete, and companies wishing to hear and see the Miller, practitioners should contact Stanley Shilling at Miller's or make proper arrangements. His address is c/o P. R. Muller & Co., Inc., La-Sageville 6, Ind.



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**THE GARNETT CORPORATION**  
**AIResearch Manufacturing Division**  
Los Angeles 41, California

## WHO'S WHERE

(Continued from page 21)

### Honors and Elections

**Education.** *Aeronautical Engineering* has announced for consideration the following members and fellows: the FIM Gold Medal to Peter Sauer, technical director of Jet Services and the designer of the Gemini; the De La Vigne Medal to Giuseppe Moscatello, General Electric; Mr. Joseph W. Rogers, USAF; and Sgt. Gen. H. H. Hays, USAF, who each took a world record during the year 1959. The Liberator Medal to Richard R. Schenck (USA) for outstanding three time world speed records for C-124 single plane category. The Prof. Tamm Award to Thomas G. Eastman, Jr., Dr. R. Lakshmi Narayanan and Dr. Walter A. Good (USA).

Robert L. Holt, vice president of Consultant Aircraft & Engineering Co., and James H. Jones, former test pilot, have both received honorary fellowships in the Society of Experimental Test Pilots for their devotion to the advancement of manned flight. The following members of the Society were also in the ranks of Fellow: Stanley M. "Tex" Johnston, former captain of the Douglas C-124, General Division of General Dynamics; Mark A. Gough, Civil Aerospace Board, Civil & Foreign, Republic Aviation Corp. The Ben G. Knecht Award for corporate contribution to flight safety and development of the DC-3 and C-47 is respectively awarded to William M. Maguire, Douglas Aircraft Co., and Jack Connelley, North American Aircraft Co. W. H. White, Jr., vice president, vice president of the Society for 1960.

Karl S. Drex, former of aircraft for American Airlines, has been elected as the new member of the Air Line Dispatchers Assn. Mr. Drex is the first member of airline management to be so honored.

### Changes

Ralph V. Whitman, director general of the National Aeronautics Assn., Washington, D. C.

Samuel W. Jones, assistant general manager, Boeing Aircraft Co. in Vandalia, Mo., has been promoted.

Ed. Cook, General Electric, has been named design and planning engineer. He has been named Gen. Electric, New York, N. Y. General Controls Corp. has established in Indianapolis, Ind., a new branch in Indianapolis, Ind. The new branch is located in the new branch of the General Electric Co. in Indianapolis, Ind. The new branch is located in the new branch of the General Electric Co. in Indianapolis, Ind.

Walter E. Adams, Jr., head, Western Control and Service Division, General Electric, New York, Ind., has been promoted.

William D. Robinson, corporate director of the General Electric Co., New York, Ind., has been promoted. He is now in charge of the General Electric Co., New York, Ind.

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**WING-CHANG BASE** Apache and Arise operate with 200 mph engine. Double dependency of 400 (wing) engine plus optional dual engine, dual hydraulic, dual vacuum system, air seat, reliable temperature.

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**Flight Star's Right Hand** with a two-engine Piper Apache or Arise, each practically proved to bring the wonderful advantage of night and day operation within reach of those present owners of single engine airplanes.

**Both the Apache, world's most popular executive twin, and the Arise, Piper's newest, faster, larger twin, are proved as a class by themselves, each many thousands of dollars less than other aircraft with similar performance. A very simple reason explains this. Many unusual parts and components used in both models—plus the highest rate of total engine production of any company—result in manufacturing efficiency and economies which keep the price down, with no compromise in dependability or quality.**

**If you're ready to increase the utility of your aircraft, consider an Apache or Arise. You'll find either of these distinguished Piper twins exceptionally easy to fly, fueling in the true Piper tradition and mostly on maintenance. You'll love its maneuverability, its long flight at night with two wonderful, dependable, Lycoming engines.**

**Pick your Piper twin today. See your Piper dealer for demonstration or write for Apache/Arise brochures, Dept. 12-W.**



**APACHE MODEL 6** Newest, four valves of the world's most popular executive twin. Can run low or high in altitude, multi-engine cabin with two 200 hp engines. Does not depend on any engine for more than 100 conventional delivery flight. Two (spinning) 100 hp engines, 100 mph, 100 mph.

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**LEAD ON FINISH** (Continued)  
any form of finish plate has developed the same Piper spirit and can still be worked out to suit your own design.

FOR PIPER'S NEW BOOKS, PAPER AIRPLANE AND OTHER PLANS, SEE THE INDEX

## BUSINESS FLYING



**PREPARED** Lockheed Super 26 has an integral cabin. FAA has granted the plane a supplementary type certificate.

## B-26 Conversion Has Rebuilt Fuselage

Ontario, Calif. — Federal Aviation Agency granted Lockheed Aircraft Service a supplementary type certificate for its pressurized Lockheed Super 26 after 11 hrs. of FAA flight testing (AW Oct. 18, p. 115).

The Super 26 is an executive transport modification of the B-26, modified by Lockheed Aircraft Service under contract for Monte Mathews Co., Pittsburgh, Pa.

The military fuselage was discarded and replaced with an enlarged cabin structure. Cabin and cockpit are pressurized. In flight tests the Super 26's pressurization system held a 5,000-ft. cabin altitude at 16,500 ft., and a cabin altitude of 5,000 ft. at 25,000-ft. altitude.

Automatic resolution surrounds the cabin and cockpit.

Thermally controlled heating and air conditioning systems maintain desired temperatures on the ground and in the air.

The rear wing area was removed so that it no longer poses through the fuselage. It was replaced by a large metal fuselage ring to which wing attachment are fastened.

The modified cabin is 22 ft. long, 6 ft. high and 4 ft. 5 in. wide. Also added to the modification are a lavatory, installation of an electrically powered Air Star door, Casella-type windows, heated windshield and necessary baggage space behind the cabin.

The Lockheed-developed and manufactured glass fiber seats contain electronic equipment and baggage space. Vertical stabilizer has been replaced for improved longitudinal stability.



**GLASS-FIBER** was on Lockheed's Super 26 executive transport provides extra space and basic aviation equipment. The Air Star door (below) is electrically actuated. The cabin within built by Lockheed is 22 ft. long, 6 ft. high and 4 ft. 5 in. wide.





354 AIRCRAFT attended FAA's annual annual fly-in at National Aviation Facilities Experimental Center, Atlantic City, N. J. Air traffic congestion was so great that the tower relinquished control to mobile radio and active runway dashboard.

## FAA's Annual Fly-In Draws 354 Planes

Athletic City, N. J.—All the pelotry in the control tower at Federal Aviation Agency's vast experimental center here couldn't cope with the swarm of light aircraft that descended when FAA staged its second fly-in for general aviation buffs.

In the hour of peak activity, a light plane was touching down at National

Aviation Facilities Experimental Center every 40 sec. Traffic tower controllers disclosed that 354 aircraft flew in for the affair, most of them within a five-minute span. Last year, FAA's first fly-in attracted 332 aircraft to this former Naval Air Station.

Inside the control center over-riding the FAA's sprawling runway

complex, tower controllers gave up after trying for most of a morning to correct the conflicting calls of inbound pilots in search of landing instructions. They relinquished control to two radio loggers in a mobile trailer stationed near the threshold of the active runway. Over several frequencies, they said: "Attention all aircraft landing 46-



LATCOMERS to NAFEL fly-in are parked on spurs. An Airline Ferry Slip Nigger (left foreground) shows itself around.



**BUT, SIR ISAAC, WE'RE NOT GUIDING APPLES!**

Until a ballistic missile is in free fall, our inertial guidance systems must be able to account for both rocket thrust and gravity. Making them this smart is a tough job, but we hit the mark so well on Thor that all of this country's long range missiles will soon be guided inertially. If you would like to help us keep pioneering new guidance systems, and have a BS, MS or PhD in Physics or Math, or an ME or EE, please contact Mr. B. A. Allen, Director of Scientific and Professional Employment, 7929 S. Howell Ave., Milwaukee 1, Wisconsin. AC 4000 000 THE ASSOCIATED SYSTEMS OF AERIAL SYSTEMS





## THE 1980's WILL BE A DECADE OF TIME COMPRESSION . . .

More people will travel farther in a shorter time—most will move in geometric orbits at 18,000 mph—space probes will shrink our celestial environment. To encompass these things, the time between research and application engineering will shrink dramatically.

Convair believes that the full potential of technology in the future will be realized through those originating in the minds of creative scientists and engineers. To encompass this mission, Convair/Fort Worth is pursuing an active research program in the engineering and physical sciences.

A position on the staff of the newly formed Applied Research Section offers opportunity mainly found for physicists and engineers at the doctoral level. Research programs in the fields of aerodynamics, telemetry, propulsion, physics of materials, and geophysics are in the formative stages of planning and execution. Active and mature programs in electronics, space mechanics, and thermodynamics are underway.

If you are capable, a position within this section will offer intense growth potential. For further information, forward your present resume to Dr. E. L. Sisson, Chief of Applied Research, Convair/Fort Worth, P. O. Box 518 A, Fort Worth, Texas.



**CONVAIR/FORT WORTH  
CONVIER DIVISION OF  
GENERAL DYNAMICS**

hairs City. Do not tolerate except in emergency. Landing left traffic Runway 15. Wind north-south at 20, gusts to 35. Altimeter 10.15. Watch for a red or green light on fuel. After landing, clear the runway to the left as last instructions.

The pilots—most were familiar with Nevada airports then with well-developed terminals such as NAFEC—had few qualms. Finding their way in the new airport pattern, even though their ground-to-air instructions stretched to eight words.

Partial wrap-up-wrap-up on the gear between NAFEC's runway at day's end were 517 employment aircraft and 77 tons. Although 23 types were represented, vintage planes, mechanical helicopters and radial designs were comparatively absent and the Piper, Cessna, Beechcraft and other private designs.

Purpose of the flight was to support general aviation with NAFEC's research and development mission. NAFEC's Convair C-119B bombers tested was an extra design, as was a Grumman F9F-8T and Grumman Gulfstream aircraft.

Dr. James L. Goodland, chief of research, Bureau of Aviation Medicine, said the flight was that FAS expected to somewhat cut pilot medical restrictions for various types of disabilities—for example, mild diabetic cases.

Exhibits set up in the laboratories and hangars at NAFEC, and equipment demonstrations, included:

- Runway light installation designs, including: variable, portable, lights; ERTS; dual-gate lights; WR-2 runway lights and back fluorescent and incandescent flood lights.
- Visual glide slope demonstration, showing the Fort Worth VGR visual glide slope installation (AW Oct 10, p. 27).
- Distance measuring equipment (Taser).
- Visual conspicuity studies of aircraft paint.
- Aircraft radio/telemetry lighting studies.
- On-line computer laboratory.
- Bell 140 telephone communication program.
- A-106C automatic ground-to-air communications development.
- Approach lighting configurations.
- Runway visual range and approach light contact height equipment.
- Traffic control operations.
- Dual approach-landing-takeoff simulator.

Bus trips were arranged so visitors could see NAFEC's Doppler VGR installation, aircraft height and speed laser color installation and F9F-8T aircraft under flight.

20-on guests also were taken to see runway lighting installation and the visual glide slope installation on Runway 13.

work in the fields of the future at NAFEC



## STRUCTURAL DESIGN ENGINEERS

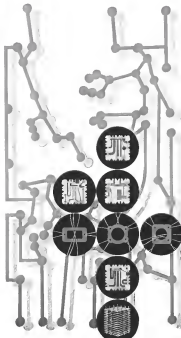
Two years engineering college plus experience desired. Will be engaged on wing and fuselage designs.

## STRESS ENGINEERS

Extensive design experience, accurate extensive structural investigation of the influence of high temperatures and unconventional external loadings. Stress engineers concerned with such structure will have the opportunity to utilize their advanced knowledge in the latest extent in the development of new analysis methods. Experience plus degree preferred.

For more information please write to Mr. A. K. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

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**NORTH  
AMERICAN  
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## ADVANCED COMPUTER RESEARCH AT LOCKHEED

Challenging new concepts in the computer field are being investigated at Lockheed's Missile and Space Division research laboratories in Palo Alto, California. Important progress is being made in pure and applied research as well as in the development of new and unusual design concepts.

Advanced research programs are being carried on in such areas as:  
Switching theory • Modular codes • Logical design • Mechanical language translation • Digital system theory • Fault-tolerant logic circuits • Thermal mode circuits • Microwave digital techniques • Magnetic thin film • Micro circuitry

Engineers and Scientists who are able to make contributions in these areas are invited to write to: Research and Development Staff, Dept. A-171B, 962 West El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

## Lockheed

MISSILES AND SPACE DIVISION

System Manager for the Navy POLARIS FEM; the Air Force AGERA Baseline in the DUCO FEM; BMD-2 and SAMOS Programs

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complete centers of  
advanced systems capability

The Columbus Division of North American Aviation is a center of total systems capability. It is the designer and builder not only of aircraft—such as the A-7F Corsair and the F-4 Phantom II—but also of missiles, radar/radio telemetry systems, and systems systems, and other diverse products. The Columbus Division is also the center of extensive advanced R & D projects. Here, there are unlimited opportunities to contribute to advanced technology—and to forward your own career.

Currently, the Columbus Division has openings for systems engineers. These engineers will assume responsibility for systems electronic systems. To qualify for these positions, one should have a background in one or more of the following fields: ECM, radar, guidance, telemetry, systems, data processing, reconnaissance or associated systems and components, and design of large digital computers. They should have a BSCE, or the equivalent, plus three years experience.

If you meet these qualifications, and seek an opportunity to advance your career, please contact us right away. Send a brief resume in confidence to:

Mr. J. A. Hittsack  
Engineering Personnel, Box AF-507  
North American Aviation, Inc.  
Columbus, Ohio

THE COLUMBUS  
DIVISION OF  
NORTH AMERICAN AVIATION, INC.



## Flying Cranes Urged On Soviet Railroads

Moscow—Official Russian government newspaper Izvestia has criticized the USSR's Ministry of Transport Construction for failing to order the use of helicopters as "flying cranes" to speed the electrification of Soviet railroads.

According to Izvestia, most railroad lines for the electrification carry so much traffic that only brief periods between train movements are available for electrification work, which depends on rail transport and equipment.

It would mean that under these circumstances it would be more expedient to use helicopters, since they can operate independently of train movements. Director of the Minsputsk Construction Construction Trust estimates that the cost of erecting a railroad electric powerline support can be cut from 600-800 rubles to 180 rubles by using helicopters. But the Ministry of Transport Construction, which is in charge of railroad electrification, says it is very unwise in this regard.

Izvestia pointed out that "flying crane" helicopters have been used very successfully in building Russian power transmission lines and gas pipelines through difficult terrain. It and helicopter designers at the M & M plant had provided assurance that their use as heliports attached to power lines would be possible. Helicopters (especially Mi-6) equipped with load hoists can give on railroad electrification projects.

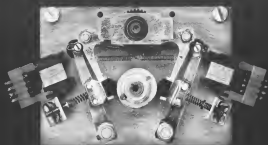
The newspaper added that it was expressed by the Ministry of Transport Construction that "flying crane" helicopters are useful for railroad electrification work because of insufficient pilot cadet and end-user maintenance of suspended loads. These problems, Izvestia said, are being solved.

## PRIVATE LINES

Mooney Aircraft Co., Tremont, Mich., will assure production of its 145 model, a four-cylinder, four-cylinder, four-cylinder engine, with the four model of the assembly line in the end of January, 1961. Mooney dropped the 145 several years ago in favor of its larger, four-cylinder 160. The 145 is 21 ft. 10 in. long, with a wingspan of 30 ft., and is powered by a 145 hp. Continental engine. Cruising speed is 163 mph at 7,500 ft.

T. Koma Co., Ltd., Japan, department state government in the British Commonwealth, will be the first Canadian company to fly the Lockheed Jet Star.

## Opportunities in Systems Development



## Harnessing a new principle of incremental drive

Now is a new way to convert high-speed shaft motion into precise increments, stepping forward, backward or rotating at intervals. It was developed from scratch by IBM engineers.

The truly clickable incremental stepper provides precise control of acceleration, runs at high speed, and has great accuracy.

### The Method of Attack

IBM engineers tackled the problem of high-speed, start-stop motion on a theoretical basis. They analyzed the loads and accelerations involved, and decided

what masses and forces would be practicable. The stepper they developed is not only more versatile and efficient than alternative methods but also gives greater life expectancy, requires no elaborate set up, and is easier to package into a machine assembly.

Whether it's a problem in mechanics, electronics or physical science, IBM engineers are encouraged to attack problems from fresh viewpoints. Depending on your field, you might be interested in the advanced IBM people are making in genetics, microelectronics, semiconductor and control

guidance. In every area of research and development, you'll find IBM receptive to the individual who wants to make significant contributions.

### How to Start an IBM Career

Right now, there are several key openings in IBM's expanding research and development staff. If you have a degree in engineering, mathematics or one of the sciences—plus experience in your field, write, briefly describing your qualifications, to: Manager of Technical Employment, IBM Corporation, Dept. 5219, 330 Madison Avenue, New York 17, N. Y.

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CONTROLS ENGINEERS  
COMBUSTION ENGINEERS  
AEROTHERMO ENGINEERS**

*for development projects  
and  
for production projects*

**SOLAR OFFERS PERMANENT** employment in a relatively new and exciting field with a tremendous growth potential. Solar is a vigorous, multi-million company founded in 1937. Solar gas turbine engines have already won an international reputation. There is an excellent balance between compensation and security with Solar.

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Applicants should have an electrical engineering degree with a minimum of 3 years actual hardware experience in the development of data recording utilizing solid state devices.

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- MECHANICAL ENGINEERS
- ENGINEER WRITERS
- MILITARY PUBLICATION EDITORS
- RELIABILITY ENGINEERS
- QUALITY CONTROL ENGINEERS
- PRODUCTION ENGINEERS
- STANDARDS & SPECIFICATIONS ENGINEERS

Send resume of education and experience to:  
R. K. PATTERSON, DEPT. 6-10

**Kensington Road  
Univac**

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UNIVAC SALES DIVISION, 2710 WEST SEVENTH STREET  
ST. PAUL, MINN. 55108



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The Boeing Transport Division is located in the unspoiled Pacific Northwest, noted for mild year-around climate, nationally famous

recreational facilities, excellent schools and housing, and beautiful outdoor Western living for the whole family.

### **MAIL COUPON TODAY**

YES, please send me more information and tell me how you can help me.

Mr. Robert W. Boyd, Transport Division, Boeing Airplane Company, P.O. Box 357, Seattle, Wash.

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ZIP CODE \_\_\_\_\_

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MAIL TO: BOEING

TRANSPORT DIVISION **BOEING**





## LETTERS

### Reply to Modaris

Recent comments by the press have piled insult on Gen. Modaris and his book "Guidelines for Defense"—which is highly critical of other military services and the Department of Defense.

As the principal responsible for the Army's Research and Development activities, I can objectively state that the views of Gen. Modaris are not wholly shared by responsible senior military officers and civilians in Washington. Critics of his specific statements regarding the manpower, training and management of major joint projects, such as Salvo and Nike Zeus, are inconsistent with the facts, and his comments on U.S. intelligence activities are both inaccurate and potentially damaging to our own interests with highly classified data.

Gen. Modaris' recent personal attack on Dr. York, into which he is recovering from a heart attack caused during his thunderbolt visit to Defense Research and Engineering, is something less than impressive. A prudent acquaintance of Dr. York's will realize the making of an ill-considered decision with regard to the main challenge although severe demands of our basic research work pressing for possible growth and expansion, which must be considered in the total context of our national policies as it evolves from our conventional dominant position to one of rapidly changing technology.

Such severity to Gen. Modaris' own proposed M-11 before proceeding to make similar operations on the same, is well in keeping of comparable future growth suggested by delays in the Pentagon routine, on which the record is well known, instead of progress and policy in the Department of Defense in its expanding research and development effort.

Under the splendid leadership of Defense Secretary Clark we now have developed a free cooperative relationship between the Assistant Secretary of Research and Development at both the National Science Foundation and the Office of Naval Research and an office of Working in close harmony with all respective military organizations. The Defense Department is clearly scoring points. Counsel of which we can assure the members presents an excellent example of free service without which would be probably neglected if otherwise with no personal connection.

The country is indeed fortunate in its wealth both within its military and civilian leadership that we have in Washington and in our 75 years of national service. I have never met a more dedicated group of associates.

Our management discusses one of our extremely difficult and complex tasks.

I appreciate that country's need and that of Congress for the development of an informed public opinion in the areas of national defense, and I am sure Gen. Modaris is highly motivated in such efforts.

We must have constructive and adequate effort willing to our national strategy, and

*defense work embraces the opinions of the conduct on the lower end of the spectrum's national consensus. Defense Review, by the Editor, Aviation Week, 1960, p. 10, New York 36, N. Y. To keep review under 100 words and give a genuine impression, the author will not permit anonymous review, but source of review will be withheld on request.*

personal organization, stages of progress, and between our military services and good experienced people willing to do so in the Washington scene. It is unfortunate books such as Gen. Modaris have written stimulate thought, the lack of objectivity and personal excessive growth makes it effective and tend to under appreciate our future contribution to national defense by the author.

ROBERT S. MESSER  
Director of Research and Development  
Department of the Army  
Washington, D. C.

### Satellite Threat

There have been articles in the past which I have noted the contents of our information on our own threat of threat in our Department of Defense. Usually these have taken the form that "if something isn't done about it, the things are going to happen to the nation." Many of these arguments I have noted as subjective, so that the opinion expressed is related from one of that content.

Now "Satellite Threat" appearing in the July 25 issue, however, states as it is even less of likelihood of the Department of Defense. You state that our efforts to produce an anti-satellite weapon system are a "dead end project" and that the new generation of satellites better be held off any way, so that the nation can get off itself. I believe that the nation can get off itself. I believe that the nation can get off itself.

I find that the language of your article is not very much different from the language of the defense budget for this year. I find that the language of your article is not very much different from the language of the defense budget for this year. I find that the language of your article is not very much different from the language of the defense budget for this year.

I am sure you that there is nothing to be lost to the concept of a satellite threat, and that you are not in a position to make the interpretation of an ICBM, except, perhaps, in the conventional possibility of attack. Therefore, I believe that the views of our nation's leaders in what would be just to do so in the Soviet weapons program, it would be to us.

There is no little difference in the views of our nation's leaders in what would be just to do so in the Soviet weapons program, it would be to us. There is no little difference in the views of our nation's leaders in what would be just to do so in the Soviet weapons program, it would be to us.

more complex guidance and control system. This more complex system is being developed to intercept an ICBM, so that, at the same time, working toward the development of a satellite threat such as you describe.

What I object to is the idea of working at all times to have a satellite threat system of our own, so that we can do so in the future. I think it is a dangerous proposition of the two, and I think it is a dangerous proposition of the two.

about it, the things are going to happen to the nation.

LOCKPORT, N. Y.

### Luaid L-59 Speed

I would like to bring to your attention an article in your magazine on p. 81 of the July 1 issue.

I refer to the maximum speed of the Luaid L-59 helicopter. The 150 mph is not a real speed, but a speed of 150 mph is not a real speed, but a speed of 150 mph is not a real speed.

C. G. KROGER  
Capt., Army  
15th Aviation Co.  
Nashville, Tenn.

(The Luaid L-59 helicopter is not from Europe, and under both the maximum speed is not a real speed, but a speed of 150 mph is not a real speed, but a speed of 150 mph is not a real speed.)

### Diode Reliability

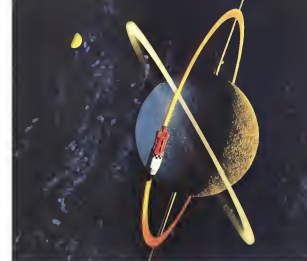
Mr. Philip J. Kline article entitled "Digital Computer Reliability Factors" published in the May 19 issue, was of extreme interest to me as the Field Instrument Co. (FIC) is a major manufacturer of diodes.

The FIC is a major manufacturer of diodes, and I am sure you that there is nothing to be lost to the concept of a satellite threat, and that you are not in a position to make the interpretation of an ICBM, except, perhaps, in the conventional possibility of attack. Therefore, I believe that the views of our nation's leaders in what would be just to do so in the Soviet weapons program, it would be to us.

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Bell-powered Agena satellites in orbit—guidance.

## THE ENGINE WITH THE FUTURE

### Reliability... Efficiency... Flexibility.

In space, these words have a million-dollar meaning.

Vast sums of money and vital scientific data ride on their built-in attributes of Bell Aerosystems' rocket engine for Lockheed's Agena satellite, second stage of the Air Force Discoverer series.

The Agena engine, designed with space in mind long before space became a household word, has fulfilled its every mission and has played more tons of useful payload into orbit than any other power plant. Its operational reliability is backed by six years of development and 5,000 test firings.

This Bell engine now has re-start capability—the first in the nation. This means that its satellite can change orbit in space without the penalty of losing engines. Presently in production, this engine also is adaptable to new fuels and new assignments and, consequently, is preprogrammed for important military and peaceful space ventures of the future.

Agena's engine is typical of the existing projects in Bell's rocket propulsion center. It is a part of the dynamic new approach of a company that's forging ahead in industry, aerospace and space techniques. These skills serve all government agencies. Engineers and scientists are now for a new kind of personal challenge can find it at Bell.



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